THE ARTISTRY OF CONSTRUCTION

An investigation into construction as a creative process and the influence of mobile phones within domestic scale construction projects

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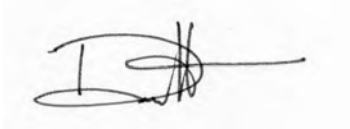
DECLARATION

This thesis has been composed by myself from results of my own work, except where stated otherwise. It has not been submitted in any previous application for a degree.



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ABSTRACT

This Thesis seeks to analyse the influence that mobile phones exert on existing communication and working practices, and on the relationships of participants involved during on-site construction. The complexity of contemporary construction makes it difficult to plot static causal relationships between communications and actions on site, not easily addressed by a managerial framework that often misses the subtleties of the construction process. The aim of this Thesis is to increase our understanding of construction as a creative process and the operational influences of mobile phones during on-site construction.

I examine the subtleties of mobile phone usage through three studies, and bring evidence to bear on the problematic of communication in construction. The first study analyses the construction of an art installation, positioning construction as a creative process. This description will inform the second and third studies, which examine the perception and usage of mobile phones within construction respectively. The narrative of this Thesis operates simultaneously along several different levels, pointing to the interconnection between creative, technological and collaborative factors that shape contemporary construction.

I advance and interrogate an alternative description of construction based on the proposition that construction is a creative process and more sensitive to the communication practices within it than is often assumed. How are mobile phones specifically, and communication technology in general, manifested in construction? Beyond the functional considerations of communication as linear channels and construction as a linear process I identify a complexity within communication that challenges established assumptions of linearity evident in much of the construction management literature, both within the construction process and within the communication technologies that it deploys. This research counters the dominant causal description of the construction process and communication within it as fixed channels for the transfer of information. Within this description the mobile phone is revealed not as a static component in a fixed place within the process of construction but as a device best conceived as a medium for tweaking, tuning and calibrating on-site processes. The mobile phone complements, supplements and challenges other communications media and procedures in the construction process. My analysis provides a description of communication technology and mobile phones within construction that asserts its fluidity, enabling a broader description of construction to facilitate further interrogation of its communication procedures and media.

Much research into the process of construction is dominated by a scientific management framework, asserting the fixed causal relationships between people. The process of building construction falls within the sciences. This Thesis challenges the exclusively scientific framing of construction and argues that there remains an underlying artistry to the process of construction, commonly theorised by philosophers in terms of “techné” and the craft inherent in the process of making. By this I mean that construction is influenced by the technological sophistication of the context in which it is being carried out. From the clay brick construction of Sub-Saharan Africa to the Millennium Bridge in London, these are a product of both communications and constructional technologies. While there exists significant

research addressing the operation of design activities under the influence of communication technologies, there is a significant gap in the research analysing their influence on working practices during construction. It is within this context that I investigate the influence of mobile phones during on-site activities.

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The title of the thesis came from Nicki Portous, who expressed what I was trying to say far better that I could. Themes in this thesis have been inspired by Nicki as well as by conversations with Martin Parker, Bruce Currey, Gerald McKenna, David Fortin and Keith Ballantyne. Ian Gunn has volunteered words of wisdom on more than one occasion that has helped my writing process. My proofreaders Desmond, Liz and Puja thank you.

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INTRODUCTION

This thesis will investigate the operational influence of communication technology within construction, paying particular attention to the impact of mobile phones. It aims to increase our understanding of the process of construction and the influence exerted upon it by mobile phones. It will contribute to the body of knowledge invested in expanding the discussion on the influence of communication technology within design and construction.[1]

PREAMBLE

There is substantial interest in the influence of technology on design activities. As computer aided design (CAD) became popularised in the early 1990s it was exposed to scrutiny.[2] CAD evolved and questions continued to arise regarding its influence on the design process.[3] While CAD workstations remained constrained to the office environment and centred on the desktop, theorists were questioning the wider influence of computing on designers and design process.[4]

Until recently this type of computing technology was expensive and lacked the robustness to be widely deployed on construction sites. However, as these weaknesses are overcome, laptops and personal digital assistants (PDAs) have percolated through the design process into the construction process. Nevertheless it has yet to benefit from the depth of analysis that we see Bijl, Coyne and Tweed perform on the design process; construction it seems is considered as being distinct and fundamentally different from design.

The computing technologies and devices that have been referred to here are usually deployed for a specific task and are being used by specially trained

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[1] Within this thesis the terminology *construction* will be used generically to refer to both the design and construction processes that are carried out during an on-site construction operation. Where it is necessary to distinguish between the processes of design and construction the terms will be used separately.

[2] Richard Coyne et al., "Computers in Practice," (Edinburgh: University of Edinburgh, 1996).

[3] Chris Tweed, "The Social Context of Caad in Practice," *Automation in Construction* 10 (2001).

[4] Aart Bijl, *Ourselves and Computers* (London: Macmillan, 1995). Also see Aart Bijl, *Computer Discipline and Design Practice: Shaping Our Future* (Edinburgh: Edinburgh University Press, 1989).

operators.[5] These proprietary devices, like CAD workstations, continue to be widely used by specific individuals in specific roles. Consequently the benefits that can be gained from their deployment are restricted to specific domains of activity. However, during the last two decades usage of mobile phones has steadily increased within the construction process and is now prolific on construction sites. Unlike these proprietary devices, a wide variety of individuals use mobile phones and their influence is widely felt throughout the design and construction process. There exist mixed opinions within the construction industry regarding the influence of mobile phones. Some perceive them as a health and safety (H&S) risk and some perceive them as devices without which they could not be competitive within the industry. While some research has been conducted by the organisation COMIT[6] and by Thomas Molony[7] to assess the impact of mobile phones within the construction industry there remains scope for further investigation into the on-site operational influence of mobile phones on the construction process.

THEMES

This section will discuss the three thematic levels on which the thesis operates: creative, technological and collaborative. The creative theme is influenced by the pre-modern terminology "poiesis," which has been translated as "poetry" in modern language. However its etymological origin has its roots in "making," which suggests that the artistry referred to in the title of this thesis is associated with the creative process of making and construction. Evidence is presented within the thesis that proves construction can make claim to the creative processes usually reserved for the discussion of design activities.

The technological theme is influenced by the notion of "techné" and its etymological origins place it firmly in the realm of craft. This brings the effect of

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[5] COMIT, *Current Status of Mobile It* (2003 [cited 27.04.05]); available from http://www.comitproject.org.uk/reports.jsp.

[6] Stands for Construction Opportunities for Mobile IT.

[7] For more on this see Thomas S.J. Molony, "Food, Carvings and Shelter: The Adoption and Appropriation of Information and Communication Technologies in Tanzanian Micro and Small Enterprises" (University of Edinburgh, 2005).

technology on human activity to centre stage and this etymological link forms the basis of the proposition that creativity and technology are not mutually exclusive domains of enquiry but are profoundly influential on each other.

The collaborative theme emerged at an early stage of this thesis and proved an important tool in the articulation of creativity and technology. This articulation brings into question the function of communication technology and the influence of both details and gaps in communicated information. Collaboration also has obvious associations with the operational influence of mobile phones and how they are perceived and used during the construction process.

THESIS OUTLINE

The thesis has been divided into three sections, each section is comprised of several chapters. This section will outline the structure of the thesis and the aim of each chapter.

Section One

- Chapter 1: Legacy of a rule-based approach to construction.
- Chapter 2: Current research.
- Chapter 3: Aim of the research and research method.

The first section of this thesis is comprised of three chapters and lays the foundations for the research that will follow in the second section. Chapter one documents the legacy of a rule-based approach to construction and with the help of Vitruvius reveals the artistic heritage of construction. It also discusses the recent initiatives for change within construction particularly during the last century; this provides a context in which to couch our observations of contemporary construction. Chapter two will take a closer look at current research within the construction domain. Reviewing this current body of knowledge will identify gaps within the current research that have yet to be fully explored. Having reflected on chapters one and two, chapter three will define a focused aim for the thesis and discuss methodologies that are suited to addressing this research.

Section Two

- Chapter 4: A description of construction as a creative process.
- Chapter 5: Perceptions of mobile phones within construction.
- Chapter 6: Usage of mobile phones within construction.

The second section of the thesis consists of three chapters, which will document three strands of distinct research. The first strand of research in chapter four will frame construction as a creative process and establish alternative means for describing it as such. Chapter four outlines the construction project that will be scrutinised and establishes the specific aim of this strand of research, which is to document the collaborative working practices and the use of communication technology during the construction project. Finally it analyses the documentation, including electronic records from message boards and transcripts from focus groups. The findings will be examined to establish key components that will form the basis of an alternative description of construction as a creative process.

Chapter five documents the second strand of the research, which will document the perceptions held by participants regarding mobile phones and mobile phones within the construction process. It outlines the specific aim for the second strand of research and the methods that will be used to document perceptions through interviews with participants in the construction process. Finally, chapter five collates and analyses the perceptions of the different participants through the alternative description of construction that was established in the previous strand.

Chapter six covers the third strand of the research, which will record the usage of mobile phones within the construction process. It describes how the third strand will be recorded, the methods used and defines its specific aim. A construction project will be scrutinised through practice-led research. The author will participate in a construction project to provide evidence on the usage of mobile phones within the working practices of participants, before analysing the usage and influence of mobile phones within the construction process.

Section Three

- Chapter 7: Analysis of the three strands of documentation: An alternative description of construction as a creative process.
- Chapter 8: Reflection on construction as a creative process and the operational influence of mobile phones during construction.

Two chapters make up the third section of the thesis, which brings together the three separate strands of research and draws conclusions on the influence of mobile phones and on construction as a creative process. Chapter seven will sum up the documentation from all three strands of the research regarding the influence of communication technology on working practices. It will use the alternative description of construction from the first strand of research as a syntactical structure to help us compare and contrast the perceptions and usage from the second and third strands. Finally, chapter eight reflects on the meaning of construction as a creative process and how mobile phones operate within that context.

1. ARRIVAL AT A CONTEMPORARY DESCRIPTION OF CONSTRUCTION

> The problem which faces us is, how do we improve our communication? It will not do to set out post-haste to "solve the problem" of inadequate communication. The most pressing task is rather to start inquiring immediately about how that problem presents itself to us.[8]

> Twentieth century physics has shown us very forcefully that there is no absolute truth in science, that all our conceptions and theories are limited and approximate.[9]

1.1. INTRODUCTION

Before explaining the purpose of this chapter let us consider the two opening provocations by Reddy and Capra. Firstly Reddy urges caution against rushing post-haste to solve problems, consequently this thesis resists the urge to prematurely define and solve a particular problem. Rather—as suggested by Reddy—it will begin by inquiring into the process of construction and how mobile phones present themselves. Secondly we consider the quotation by Capra, aware that different participants within construction—like Capra's scientists—engage with their individual and thus limited or approximate conception of construction. This thesis, in line with Capra's suppositions of truth, challenges the construction sector's dominant description of construction as a purely functional process of fabrication and assembly, which continues to influence the perceptions and evolution of construction. Through an alternative description of construction as a creative process this thesis aims to create a richer understanding of the construction process and of the operational influence exerted upon it by mobile phones.

The purpose of this chapter is to understand how construction is described within a contemporary culture that places considerable value on efficiency. Within this culture, systemisation and technological developments dominate the discourse; it

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[8] Micheal J Reddy, "The Conduit Metaphor: A Case for Frame Conflict in Our Language About Language," in *Metaphor and Thought*, ed. Andrew Ortony (Cambridge: Cambridge University Press, 1979), p. 187.

[9] Capra, *The Turning Point: Science, Society, and the Rising Culture* (London: Fontana Paperbacks, 1984) p. 42.

will trace this domination from Vitruvius through to modern construction and demonstrate that traces of artistry still remain within this contemporary description. This chapter will be conducted in three parts; firstly we review the *legacy of a rule-based approach to construction*, starting with the early writing of Vitruvius through to more recent evolutionary changes in construction. This will include developments of an economic and technological nature and events that have influenced the current form of construction. Secondly, this chapter will also look at some of the *recent initiatives* that have been implemented to address the changing shape of the business and execution of construction; this will include methods of procurement and Modern Methods of Construction (MMC). It is within this context that we start to see the implementation of the technological components that are of particular interest within the context and aims of this thesis. Thirdly we will look at the *effectiveness of these initiatives* and whether or not they achieve their goals to make construction a more effective process.

1.2. LEGACY OF A RULE-BASED APPROACH TO CONSTRUCTION

Mobile phones are a relatively recent addition to the construction process; first appearing approximately 25 years ago in the mid-1980s they were expensive and bulky. As the size and cost of mobile phones reduced, builders and other transient workers were quick to appropriate them. Now the role of mobile phones within design and construction seems to be well established. Opinion, however, is polarised as to whether they are beneficial or problematic to the construction process. The appropriation of technologies—like mobile phones—is a theme that runs through the legacy of a rule-based approach to construction, and it will be discussed further in section 1.3. This section of the chapter will review some of the historical developments that have shaped construction, to help contextualise our understanding of contemporary construction and the high value it places upon systemisation and rules.

When discussing the legacy of a rule-based approach to construction there is no one better to begin with than Vitruvius. According to McEwen, Vitruvius was—until the eighteenth century—referred to by virtually all other authoritative

architectural texts.[10] Within the historical context of design and construction what is of interest is something Vitruvius establishes in the preface of book one of *The Ten Books of Architecture*.

> I have drawn up definite rules to enable you, by observing them, to have personal knowledge of the quality both of existing buildings and of those which are yet to be constructed. For in the following books I have disclosed all the principles of the art.[11]

Vitruvius implies in the opening preface—of what was considered the authoritative source for design and construction of public buildings—that the quality of buildings can be contained in rules. The Ten Books on Architecture are exhaustive in establishing rules for building orientation, doorways, harmonics, climate, colours and celestial influence. According to McEwen, Vitruvius and this manuscript continued to be substantially influential within design and construction well into the eighteenth century.

Both McMordie and Rawlins have also identified a propensity for rule-based construction within the eighteenth and continuing into the ninetieth century, when tradesmen used *pattern books* extensively.[12] These books contained set patterns for plastering and stonemasonry that could be reproduced as desired by clients. The 1900s brought with them a revolution in architectural design and theory at which point we see alternatives to Vitruvius emerged. Even in the radical aesthetics of Le Corbusier and his influential writings in *Vers Une Architecture,*[13] we find in Le Corbusiers' Le Modular the Vitruvian foundation of rule-based organisation. Pérez-Gómez might attribute this modern domination of rule-based organisation within architecture to the *Enlightenment*, referring to the rupture within art and science after

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[10] According to McEwen there is evidence of another authoritative text from the sixth century. It is the Vitruvian text, however, which has exerted more influence. For more on this see Indra McEwen, *Vitruvius: Writing the Body of Architecture* (London, England: The MIT Press, 2003) p. 1.

[11] For more on this see M Vitruvius Pollio, *Vitruvius the Ten Books of Architecture*, trans. M.H. Morgan (New York: Dover Publications, Inc, 1960) p. 4.

[12] For more on this see Michael McMordie, "Picturesque Pattern Books and Pre-Victorian Designer," *Architectural History* 18 (1975). Also see T. Rawlins, *Familiar Architecture; Consisting of Original Designs of Houses for Gentlemen and Tradesmen, Parsonages and Summer Retreats.* (1768).

[13] Le Corbusier, *Vers Une Architecture*, trans. Frederick Etchells (Oxford: Architectural Press, 1987).

which architecture became dominated by science and its foundation of systematic and predictable causal relationships.[14]

1.2.1. Rule-based organisation and systemisation in construction

When Le Corbusier coined the phrase 'machines for living'[15] he was referring to the metaphorical machine characteristics of purity of functional components existing in an efficient harmony. However, the machine-like efficiency and clarity practiced by architects in the design politics of these buildings, such as the Schröder House (Figure 1.1), were not reflected in the machine-like clarity of their construction. In fact, the construction of the Schröder House like many of that period[16] was traditionally rendered brick and mortar, which was made to look like concrete. Arguably this undermines the functional and systematic ethos that these designs were trying to establish, and it could be argued that the brick terraced houses (Figure 1.2) found alongside the Schröder House are more true to the machine politic in their construction, in terms of their economy of scale and material honesty.[17] The Schröder House and many other buildings in that style were often more difficult and less efficient to construct than traditional styles. This demonstrates how the adoption of rules, in this case for organisation and aesthetic purposes, does not necessarily directly translate into the efficient construction of a building.

[14] This position has been critiqued in detail by Pérez-Gómez. For more on this see Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science* (Cambridge: MIT Press, 1983).

[15] Corbusier, *Vers Une Architecture.*

[16] Early Modernist private houses in the UK started with such efforts as Le Château at Silver End by T.S. Tait (with Frederick MacManus) (1927-8). They were finished with render over a brick structure, trying to emulate the appearance of concrete. For more on this see Banister Fletcher, *A History of Architecture on the Comparative Method: For Students, Craftsmen & Amateurs* (London: Batsford, 1956) p. 1351.

[17] Broadbent has explored this criticism of inconsistency between form and meaning in greater depth, see Geoffrey Broadbent, "Meaning into Architecture," in *Meaning in Architecture*, ed. Jencks Charles and George Baird (London: Barrie and Rockcliff, 1969).

Figure 1.1 Modernist Schröder House

Figure 1.2 Schröder House in context with traditional terraced house

Still, even Le Corbusier could not have envisaged his machine for living ethos would have been so transformed. In the latter half of the 1900s the speculative construction industry developed a machine-like efficiency in the production of virtually identical houses. In light of the industrial standardised buildings of the speculative construction industry, Ruskin's concerns of industrialisation being dehumanising seem well founded, as do his criticisms of architecture adopting

industrial principles and creating standardised buildings.[18] Efficiency and cost effectiveness in the form of increased profits or more affordable buildings are typical drivers for change within the construction sector.

Continuing with the theme of efficiency, the construction industry seemed to draw inspiration from the standardisation and systemisation that was occurring in the automotive industry,[19] which was streamlining car construction into efficient production lines of prefabrication and assembly. In doing so—particularly the Ford Motor Company—was achieving an increase in profits and the creation of affordable products. Drawing inspiration from the Ford Model T prefabrication and assembly process, the construction industry looked to emulate the success in the automotive sector,[20] before long it was applying the prefabrication and assembly to the construction process.

The transfer of prefabrication and assembly from the controlled environment of the automotive factory to the less predictable and less controlled construction site was not a simple transition. This was tragically illustrated at Ronan Point in 1968, when a domestic gas explosion on the upper floor of a residential tower block caused a catastrophic collapse.[21] Floor slabs experienced structural failure as the slabs above collapsed onto them, resulting in a cascade effect and structural failure from the upper to lower floors. The cascading failure of the floors at Ronan Point was attributed to flaws in the prefabrication and assembly process which proved much

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[18] Ruskin resisted and criticised industrialisation and standardisation and within the current context of this thesis his arguments have currency. However Ruskin's arguments are not without their critics, see Kristine Ottesen Garrigan, *Ruskin on Architecture* (Wisconsin: The University of Wisconsin Press, 1973) p. 145-50.

[19] For current discourse on the influence of manufacturing and automotive production processes on construction see Lauri Koskela and Ruben Vrijhoef, "Is the Current Theory of Construction a Hindrance to Innovation," *Building and Research Information* 29, no. 3 (2007).

[20] For a more detailed review of prefabrication in the post-war period see Nicholas Bullock, "You Assemble a Lorry, but You Build a House: Noisy-Le-Sec and the French Debate on Industrialised Building 1944-49," *Construction History* 22 (2007).

[21] *Three Die as Tower Block Collapses*, (BBC, [cited 27.11.07]); available from http://news.bbc.co.uk/onthisday/hi/dates/ stories/may/16/newsid 2514000/2514277.stm "A public inquiry into the collapse in August 1968 concluded that a gas explosion had triggered the collapse of a building that was structurally unsound. It had been "system-built" using prefabricated concrete panels bolted together like a giant meccano set." Further critique of prefabrication in construction can be found in Koskela and Vrijhoef, "Is the Current Theory of Construction a Hindrance to Innovation."

more difficult to monitor on a construction site than in a controlled factory environment.

Construction continued to search for ways to improve efficiency, including the JIT (Just In Time) model that had evolved from the Kaizen construction method found in Japan. These models attempted to avoid costly stockpiling by promoting construction organisations to provide materials and services just in time, thus maximising the efficiency of both their time and resources. Construction was being closely compared to other sectors adopting prefabrication and assembly systems. Although it could be argued that prefabrication has lead to the evolution of Modern Methods of Construction[22] (MMC) such as volumetric and panelised construction, which at the time of writing are beginning to achieve some level of notoriety and success. By the 1990s the manufacturing sector in particular was showing striking financial benefits[23] from this initiative.

1.2.2. Sub-contracting: The Nike model

Figure 1.3 Productivity Index of US Sectors (copyright AIA April '03) illustrates an unexpected phenomenon, productivity within construction (indicated as AEC standing for the Architectural, Engineering and Construction sector) falls as the manufacturing principles of prefabrication and assembly were implemented between the 1970s and 2000. While the manufacturing sector was steadily improving from the implementation of these changes, the construction sector was not. The principles as applied to the construction sector did not have the same anticipated effects they were having in the manufacturing sector. Similar changes that produce different results within the construction and manufacturing sectors suggests perhaps a fundamental difference between construction and manufacturing. If this were the case it would challenge continued attempts to compare and map processes from manufacturing to construction.

[22] MMC is the generic term used to encompass volumetric, panelised and other new strategies for construction. These will be discussed further in section 1.3.2.

[23] Graham Ive et al., "Industry, Economics and Statistics: Measuring the Competitiveness of the Uk Construction Industry " (London: University College of London 2004), p. 8.

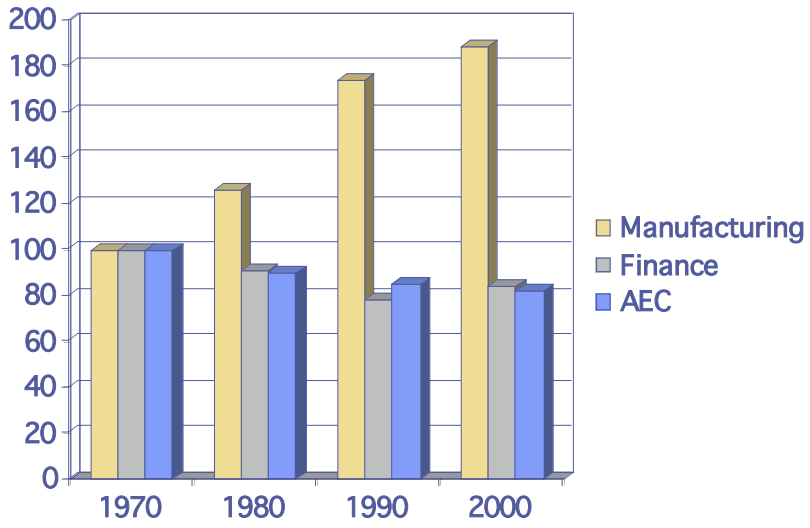

Figure 1.3 Productivity Index of US Sectors (copyright AIA April '03) showing drop in productivity of AEC sector

The practice of intensive sub-contracting has recently been referred to as the Nike model, referring to the athletic company that produces footwear and clothing. While Nike did not invent the practice of sub-contracting, the company developed it to unprecedented levels,[24] which is why it warrants a brief discussion within the context of this thesis. The manufacturing and finance sectors could sub-contract components of work elsewhere;[25] as a consequence of the lower labour costs from this sub-contracting, these sectors were becoming more and more productive as costs and direct employment figures fell.[26]

[24] *Nike to Cease Manufacturing Products*, (The Onion, 2007 [cited 07.05.07]); available from http://www.theonion.com/content/node/39276.

[25] For manufacturing, China has become the country of choice for sub-contracting and the financial sector favours the Indian subcontinent.

[26] Nike employs approximately 500,000, but only 22,658 directly at the time of writing. For more on this see R. M. Locke and A. J. Siteman, "The Promise and Perils of Globalization: The Case of Nike."

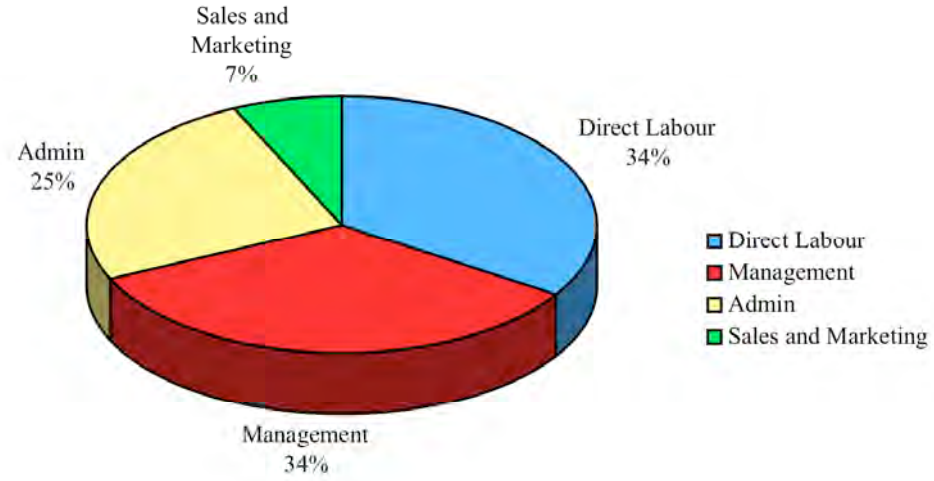

Figure 1.4 Typical construction organisation labour distribution showing direct labour only accounting for 1/3 employees

In this section we have revealed how construction has been driving to increase efficiency by focusing on the adoption of similar management structures to the manufacturing sector by employing minimal direct labour and sub-contracting the maximum percentage of work to other organisations. The labour distribution in a construction organisation is illustrated in

Figure 1.4,[27] it reveals that only approximately one third of employees are engaged in direct on-site labour. The direct labour comprises of mainly interstitial employee roles for driving and general labouring duties etc. This is distinct from another third of the staff engaged with the management of the sub-contracted construction components; these are project and site engineers. The remaining employees such as accountants and quantity surveyors are invested in the administration of construction projects, with a small percentage dedicated to the sales and marketing of the projects.

[27] See Appendix A.2, interview 1.

1.2.3. Differences: Manufacturing and construction

A typical construction organisation by drawing from the manufacturing model will subdivide a construction project into individual sub-contracted components such as foundations, windows, cladding etc. By competitively tendering these components they can then achieve a lower construction cost, avoid large financial overheads and—as we have identified in the previous section—only employ minimal direct labour when it is required. However, Figure 1.3 illustrates these changes to the structure of construction organisations have not produced the same quantitative benefits when measured against the manufacturing and finance sectors.

As we have discussed, parallels are often drawn between construction and other sectors that have achieved success from the adoption of manufacturing principles. In embracing similar principles, construction organisations have attempted to emulate that success. The failure to achieve that success draws attention to the differences—rather than similarities—between construction and manufacturing, which are perhaps preventing this. Although manufacturing and construction are both site specific and each assembles components that have been manufactured elsewhere, the critical difference, as illustrated in the collapse of Ronan Point, is that the construction site environment cannot be controlled to the same extent as an assembly line environment. For example, construction sites are at the mercy of the weather, usually limited to hours of daylight and sub-contractors may have esoteric methods of construction that conflict with others. The automation of prefabrication and assembly found within the manufacturing sector becomes problematic within the noise and furore of the construction site.

For the social critic Marx this process of automation is less about the potential prosperity it might facilitate in the form of more cost effective products, rather he argues that automation “transforms the worker’s operations more and more into mechanical operations, so that, at a certain point, the mechanism can step into

his place."[28] The construction of a building is often approximated as being a prescribed process, which will be discussed in greater depth in chapter two. Arguably this focus on prescription is at the expense of the more potent and arcane activities within construction, which are of interest within the context of this thesis. Consequently, certain activities within construction may inadvertently be devalued as others are brought to centre stage through this process of remodelling. Participants, processes and communications fragment as the construction sector adopts this manufacturing paradigm, communication technologies like mobile phones emerge to compensate and create new communicative possibilities that have yet to be fully explored.

It could be argued that the playing of a piano is the repetitive striking of keys and the playing of a banjo the repetitive plucking of strings. A construction site is perhaps like a piece of music, in a fluid ever-changing state of flux as it changes both temporally and experientially. However, the focus on the ceremonial *ground breaking* at the beginning of construction and *topping off* when participants regroup to celebrate the completion[29] is perhaps another suggestion that the construction sector invests little value in the process of construction has a greater focus on the finished product. Any artistry that takes place between these two ceremonial markers is not appreciated, at least not in the same way that a piece of music might be appreciated.

To summarise, this section has reviewed the legacy of a rule-based approach to construction, throughout which we can identify a clear trend that emerged from The Ten Books on Architecture and continued through the 1900s and into modern methods of construction, which attempts to contain construction within a rule-based framework. The trades of historical construction—particularly masonry and carpentry—were often recognised as craftsmen and elements of artistry were acknowledged in their craft. Nevertheless, the contemporary notion of construction is

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[28] For more on this see K Marx, "Grundrisse," in *Karl Marx: Selected Writings*, ed. D. McClellan (Oxford: Oxford University Press, 1977), p. 379.

[29] The topping-off ceremony is not necessarily the completion of a construction project, when the Petronas Towers in Malaysia were topped off there was much work still to be completed inside. The topping off was more of a celebration of the completion of its appearance.

focused on systematic assembly and within this modern framework the more arcane elements of this artistry seem to have been devalued. We shall see in the following section that the manufacturing paradigm continues to influence change and promotes construction as a systematic process of fabrication and assembly.

1.3. RECENT INITIATIVES AND CHANGE

In this section we will review recent initiatives and the changes they have brought to construction. Firstly we will study influential government initiatives in the form of *the legacy of the Latham and Egan* Reports. The Government commissioned these two wide-ranging reports to propose recommendation for improving the construction process. We will begin this section by discussing the legacy of these reports and their effects on the construction process. Secondly we will review *restructuring* initiatives in construction, the implementation of partnering management structures that emerged from these reports and also discuss the influence of Modern Methods of Construction (MMC). Thirdly we will review initiatives in the form of *technological interventions* in the design and construction processes.

Historically construction has evolved to accommodate its socio-political landscape and to embrace the new technologies that become available to designers and contractors. Through the 1980s and 1990s rapid computer software and hardware developments enhanced design, construction and management within the sector.[30] By the 1990s CAD (Computer Aided Design) software was maturing beyond simple Computer Aided Drafting with the integration of more sophisticated functionality. It could now assist with project management and co-ordination during design and construction, these technological advances will be reviewed later in this chapter. While there is a fascination with these sophisticated technologies, it is worth noting that during the same period, mobile phones were clandestinely finding their way into

[30] In 1983 the International Council for Research and Innovation in Building and Construction (CIB) was set up and initially focused on Computer Aided Design (CAD) systems, it has since widened its remit to include general Information Technology (IT). The European Commission also funded several initiatives focused on innovation using IT. For more on this see Sarah Bowden et al., "Mobile ICT Support for Construction Process Improvement," *Automation in Construction*, no. 15 (2006): p. 665-66.

design and construction. However, it has only been in the last five years that initiatives such as COMIT[31] (Construction opportunities for Mobile IT) are starting to explore the opportunities afforded by mobile phones within design and the construction process.

1.3.1. The Legacy of Egan and Latham

Both of these reports refer to the manufacturing sector, either to suggest that lessons can be learnt from the systemisation and automation that has increased the efficiency of manufacturing or to suggest that construction can draw inspiration from manufacturing's higher level of coordination and the closer relationships that exist between the various participants. According to government figures construction absorbs a substantial amount of money,[32] in 1993 over 60% of this was in the form of government appointed contracts.[33] There are clear financial incentives for government to improve the means by which construction projects are procured and where possible to improve the efficiency of the construction process. The Latham Report published in 1994 and the Egan Report published in 1998 explored ways of improving productivity within construction, in the words of the Latham Report, "helping clients to obtain the high quality projects to which they aspire."

The specifics of each report varied, the Latham Report focused on the procurement and contractual aspects aimed to "enhance performance in a healthier atmosphere"[34] in construction. It aimed to contribute to closer working relationships. The culmination of the report was a list of recommendations, which included proposing systems to maintain better and more consistent working relationships such as "Co-ordinated Project Information"[35] and "Main Contractor and Sub-Contractor

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[31] COMIT, *Current Status of Mobile It* ([cited 27.04.05]).

[32] In 1993 the value of output from the construction industry was £62.8 billion and in 2006 it was £80 billion. For more statistics on construction output see Frances Pottier and James Achur, "Construction Statistics Annual 2007," ed. Department for Business Enterprise & Regulatory Reform (London: 2007). Also see , (Department for Business Enterprise and Regulatory Reform, 2007 [cited 13.08.07]); available from http://www.dtistats.net/construction/output/.

[33] Sir Michael Latham, "Constructing the Team: Final Report," (London: H.M.S.O., 1994), p. 8.

[34] Ibid., p. v.

[35] Ibid., p. 27.

Lists."[36] The proposal of these recommendations has proved easier than implementation.[37] For example, although Latham proposed partnering—which will be discussed later in the chapter—as a procurement route that would contribute to closer working relationships, it was only after the Egan Report that it was widely implemented.

In its Executive Summary the Egan Report identifies the five drivers of construction as:

> Committed leadership, a focus on the customer, integrated processes and teams, a quality driven agenda and commitment to people as key to the government's agenda for improving quality and efficiency.[38]

Recent research by Amaratunga continues to allude to efficiency as an important driver for change within construction.[39] With annual government targets to reduce construction costs and time by 10% and project defects by 20%,[40] the Egan Report championed partnering amongst other principles to achieve this. Contrary to being a successful recipe for construction—although it has been widely adopted as a construction procurement method—Taylor and other critics argue partnering has produced mixed results.[41]

1.3.2. Restructuring: Partnering and MMC

New procurement methods such as partnering in the form of PFI and PPP and alternative construction methods such as MMC provide a variety of different structures by which construction can be successfully executed. PPP (Public Private Partnering) and PFI (Private Finance Initiative) were recommendations born of

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[36] Ibid., p. 51.

[37] For further discussion on the implementation of the Latham Report see Christopher Hill, "Latham's Legacy," *Building*, no. 50 (2001).

[38] Sir John Egan, "Rethinking Construction: The Report of the Construction Task Force," (London: Department of Trade and Industry, 1998), p. 3.

[39] Dilanthi Amaratunga, David Baldry, and Marjan Sarshar, "Process Improvement through Performance Measurement: The Balanced Scorecard Methodology," *Work Study* 50, no. 5 (2001).

[40] Egan, "Rethinking Construction: The Report of the Construction Task Force," p. 4.

[41] Mike Bresnen and Nick Marshall, "Partnering in Construction: A Critical Review of Issues, Problems and Dilemmas," *Construction Management and Economics* 18, no. 2 (2000), David Taylor, "Partnering Will Tear Us Apart," *Building*, no. 24 (2003).

Latham and Egan and championed by the government as a means of achieving improvements in the quality and efficiency of the construction industry through closer relationships. PPP is a contractual arrangement that would provide the participants with a more integrated team based structure thus facilitating closer relationships throughout a construction project. It was envisaged particularly for large public contracts, where a public body client would partner with a private construction organisation for the duration; as in the *pathfinder* projects[42] where local councils partnered with construction organisations for the extensive refurbishment of council houses. This arrangement would move away from the "formal communication and documentation between the project partners to a well structured, but more open and informal communication."[43] Egan cites several examples[44] including Tesco who saved 20% and other private companies who saved up to 30-40% of capital costs by implementing a partnering strategy with construction organisations. However, there has been debate regarding the substantial returns gained by private investors in such agreements and the suggestion that the cost of buildings procured in this way could actually be higher for the government and thus the taxpayer than traditional methods of contractual arrangement.[45]

PFI is another contractual arrangement that encourages the private financing of public construction projects, relieving the government of the financial burden. This has also produced mixed results. While the government acknowledged that it provides "greater certainty on the timing and on the cost,"[46] Weaver casts doubt on whether there are tangible improvements to either the process of construction or the quality of the finished product.[47] A report to the House of Commons in 2003 echoes

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[42] For more on this see M Weaver, *Government Admits Problems with Pfi Home Repairs* (2005 [cited 22.06.05]); available from http://www.guardian.co.uk/society/2005/jun/22/privatefinance.politics/print.

[43] O Laedre and T. I. Hangen, "Use of Project Partnering in Construction" (paper presented at the Construction Economics and Organization, Gothenburg, 2001), pp. 1.

[44] Egan, "Rethinking Construction: The Report of the Construction Task Force," p. 9.

[45] "Pfi Construction Performance," (London: House of Commons Committee of Public Accounts, 2003), p. 9.

[46] Ibid.

[47] Weaver, *Government Admits Problems with Pfi Home Repairs* ([cited).

the concerns that the returns for a private investor—when engaged in this form of contractual arrangement—are unreasonably high. It also suggests that in 20% of cases the functionality of the buildings does not meet the intended design brief.[48]

Criticisms of PFI are usually focused on monetary issues, either concerns that the private investor is gaining disproportionate returns on the project, or that the project costs more under PFI than under traditional government funding. However, the House of Commons report also suggests that both PPP and PFI forms of contractual arrangement are producing buildings that require modification shortly after completion. This does bring into question the suitability of these types of contractual arrangement to address design briefs and deliver functionally satisfactory buildings. PPP is not immune to further criticism either and the design profession is often vocal regarding their diminished role.[49] Designers are often contractually bound within the PPP procurement structure to relinquish their design authority at an agreed juncture in the project. While these new arrangements have had an effect on the construction process and building quality, it is unclear from the evidence if it has been—on balance—a positive one. Current research by Jones and Kaluarachchi suggests that the absence of and need for trust is one of the main obstacles to these methods of procurement.[50]

The *design and build* procurement method also challenges initiatives that are aimed at increasing the rigidity of design and construction. Within this structure the construction process advances iteratively, parts of the building such as foundations would be designed and built, only when required would the walls be designed and built. It was envisages as a much faster method of construction as design and construction were proceeding in parallel. It is favoured by people wishing to self-

[48]Report to the House of Commons states that a few years after completion, 20% of buildings put in a request to change the facilities. For more on this see "Pfi Construction Performance," p. 1.

[49] In the case of partnering a design solution may be passed from an original design professional to a construction organisation or their appointed design professional that then would modify it to be constructed cost effectively without the consent of the original designer.

[50] For more on this see Keith Jones and Yamuna Kaluarachchi, "Operational Factors Affecting Strategic Partnering in Uk Social Housing," *Engineering, Construction and Architectural Management* 14, no. 4 (2007). Also see Keith Jones and D. Kaluarachchi Yamuna, "Monitoring of a Strategic Partnering Process: The Amphion Experience," *Construction Management and Economics* 25, no. 10 (2007).

build, abandoning a main building contractor and managing the design and build process also affords greater personal control of the finished building.[51] It is also seen to have higher environmentally sustainable credentials.[52]

We also have cause to reconsider traditional structures of construction in light of MMC techniques such as volumetric and panelised construction. With both these methods considerable construction occurs off-site, and on-site construction becomes a process of assembly. Thanks to high profile design competitions[53] demonstrating the design potential when constructing with MMC, preconceptions of prefabrication and the legacy of Ronan Point have largely been forgotten. However, there are concerns that the speed[54] afforded by these methods of construction is at the expense of flexibility and the facilitation of design changes during on-site activities. Depending on the particular circumstances of construction and the value placed upon speed, cost and personal control, there are many alternative structures within which construction can be successful.

Returning for a moment to the aim of this thesis, what is the role of mobile phones within the context of this restructured construction environment? As the prescriptive formal communication structures and processes of construction evolve, so to do the informal. The appropriation of mobile phones—for the moment at least—seems destined to be considered an unofficial communication device, which is used within these official communication structures. Within this context mobile phones are typically brought to centre stage when they become problematic. However, it is unlikely their influence is limited to being exclusively problematic. It

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[51] Design and build is not without its critics. The popular television program *Grand Designs* often illustrates design and build degenerating into perpetual changes resulting in long and frustrating building programs.

[52] Within the current financial and environmental climate Tom Woolley continues to construct and report on the value of the design and build methodology. For more on this see Tom Woolley, *Natural Building : A Guide to Materials and Techniques* (Ramsbury: Crowood, 2006).

[53] For more on this see *Design for Manufacturer Competition*, (English Partnerships, 2007 [cited 07/04/09]); available from http://www.englishpartnerships.co.uk/designformanufacture.htm. Also see *Dwell Home Design Competition*, (archiCentral, 2008 [cited 07/04/09]); available from http://www.archicentral.com/dwell-home-design-competition-1684/.

[54] The HUF House system has been reported to being assembled and watertight in as little as seven days. See *Huf Haus*, (Huf Haus, [cited 07/04/09]); available from http://www.huf-haus.com/gb/intro.html.

is equally probable they exert positive influence on the construction process, yet when mobile phones fail to create a problem they go unnoticed. It is inconclusive if restructuring official communication channels and relationships—as we have discussed—has produced positive results. This suggests that unofficial communication channels and technological interventions such as mobile phones may make profound and influential contributions to effective communication and thus to a successful and efficient construction process. It is with this in mind that we attend to the less formal aspects of construction and communication within this thesis.

1.3.3. Technological interventions: 'Virtually' seamless models

It was the Latham Report that brought the co-ordination of information during a construction project to centre stage. The development of CAD and in particular the notion of the *virtual building* model, which has been emerging over two decades, seems to resonate with Latham's vision of co-ordinated project information. As projects continue to fragment[55] further into more specialised sub-contracted components, emergent technologies and software have the potential to assisting with the increasingly complex and difficult task of co-ordinating fragmented information and disparate participants.

The construction sector continues to champion technology that enhances co-ordination, for the moment these technological developments seem to have converged into what is being widely described within the construction industry as BIMs (Building Information Models). BIMs are the most recent in a succession of software developments that aim to assist with the co-ordination of the various participants of a construction project, if it is provided with the appropriate data. In the early 1990s the ArchiCAD software from Graphisoft had already evolved beyond computer-aided drafting and could generate documentation such as sections, elevations and plans from a virtual three-dimensional building model. Subsequent

[55] For current discourse on the fragmentation of construction see Koskela and Vrijhoef, "Is the Current Theory of Construction a Hindrance to Innovation." Also see Bingunath Ingirige and Martin Sexton, "Intranets in Large Construction Organisations: Exploring Advancements, Capabilities and Barriers," in *ITCon* (2007). Also see Chaminda P. Pathirage, Dilanthi G. Amaratunga, and Richard P. Haigh, "Tacit Knowledge and Organisational Performance: Construction Industry Perspective," *Journal of Knowledge Management* 11, no. 1 (2007).

changes to the virtual model would then be automatically reflected in the documentation. To obtain these benefits in practice it was necessary to invest more time in the creation of the virtual model. This ensured the software would generate accurate documentation. Although this was possible, it was not necessarily economically practical. By the late 1990s, teamwork functionality was emerging and assisting with the coordination of the distribution of work. Different parts of a building could now be assigned to different individual staff and the CAD software would ensure that the different participants did not encroach on each other's work. These individual changes would then be integrated in the overall virtual model.

More recent developments have been focused on information rather than documentation and BIMs have evolved promising to co-ordinate information from engineers, architects and quantity surveyors in a holistic manner. The construction sector is clearly excited by this potential, however the BIM methodology also has its critics. Chris Yessos, the CEO of auto•des•sys has critiqued the limitation of BIMs and suggests they limit design freedom. His criticism is that in its current form BIM methodology can only be applied to designs that are simple in their geometric form, thus employing such systems in the design process could potentially restrict design freedom.[56] The implication being that even if BIMs live up to expectations and relieve us of mundane tasks within design and construction, this relief is potentially at the expense of the creative process of design and construction.

In this section we have reviewed the recent initiatives within construction. By attempting to emulate manufacturing the construction sector has continued to strive for more rigid structures and systemisation within design and construction. However, statistical surveys provide no conclusive proof that construction projects implementing these changes improve either their productivity or efficiency. Contractual structures, such as PFI and PPP create more fragmentation of the design and construction team and process. Consequently the process requires more complex coordination and those charged with coordination resist deviation from the established process. However, techniques such as design and build and MMC

[56] C Yessos, "The Singularity of Design Creativity" (paper presented at the Communicating Spaces, Volos, Greece, 2006), pp. xii.

demonstrate that a variety of structures for construction exist that suit different programmatic needs that place dissimilar values on design freedom, speed and cost. Virtual modelling software has resulted in more elaborate design descriptions and an increase in the volume of construction information. The trend in technological development continuing to increase rigidity during design and construction has prompted Yessos to argue that achieving these organisational and management aims may be at the expense of creative freedom within the working practices of design and construction.[57]

1.4. EFFECTIVENESS OF INITIATIVES

In this section we will review the recent results from the implementation of the initiatives discussed in the previous section and assess their effectiveness. We will review the effectiveness of these results under the themes of *productivity* of the construction process, the influence of *technology* within the process and the *quality* of the products of the construction process.

1.4.1. Productivity and other goals

Turing again to mobile phones, although they are commonplace within design and construction, their potential as a means to deploy technology and software is only now being realised. For the most part they have been notably absent from recent initiatives in the construction sector. Where they are receiving attention is in health and safety policy and whether or not their use on construction sites may contribute to accidents,[58] which suggests they may be negatively affecting productivity during construction. However, research into the cause of accidents

[57] Ibid.

[58] While the Health and Safety Executive (HSE) acknowledges that falls from low heights are a problem and suggests there may be a link with mobile phone usage, there does not seem to be conclusive statistical proof. This may be caused by participants being reluctant to admit a mobile phone was a contributing factor to accidents. See Buildingtalk, *Mobile Phone Culture Puts Tradesmens Lives at Risk* (Buildingtalk, 2006 [cited 06.08.08]); available from http://www.buildingtalk.com/ news/hse/hse201.html.

during construction by Haslam has not explicitly linked mobile phones to site accidents.[59]

We have previously discussed Latham and Egan's reports, which are both focused on improving productivity, The recommendations that emerged from the Latham report favoured a more systematic and formal approach to the procurement and contractual arrangement of construction. Egan looked specifically towards manufacturing on the basis that it is analogous to construction and suggests improvements through the re-engineering of the construction process. Building upon the Latham Report, Egan promotes partnering, which—contrary to Latham's recommendations of a more formal and systemic approach—actually affords more informal communication possibilities between the partners.[60] This again implies that perhaps both formal and informal communication channels have value within the process of construction.

We have discussed the similarities and differences between the construction and manufacturing process in section 1.2.3. This section challenges the construction/manufacturing comparison made by Egan and contests that it may not be a constructive comparison. The mixed results from adopting these principles in the construction sector reinforces the claim that a manufacturing analogy—as illustrated in Figure 1.3—does not produce a clear improvement in term of productivity.

Although only a small proportion of Latham's recommendations were ever implemented, there is evidence to suggest they have improved the efficiency of building delivery in terms of time and cost. However, it seems the construction industry as a whole felt it was neither desirable nor possible to re-engineer the construction process to the extent Latham recommended. After more than a decade of these implementations there is still no consistent evidence that they produce consistently positive effects in terms of productivity. When there have been productivity improvements in terms of time and cost of building delivery as cited in

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[59] R. A. Haslam et al., "Contributing Factors in Construction Accidents," *Applied Ergonomics* 36 (2005).

[60] Laedre and Hangen, "Use of Project Partnering in Construction", pp. 1.

the House of Commons report,[61] the quality of the building seems to be compromised.

Within these initiatives, the technological components of construction continue to grow, having evolved from simple drawing software into modern computing technologies. Software developments gravitate towards accumulating and coordinating a greater volume of information before construction begins. Within the manufacturing paradigm adopted by the construction sector this should produce a more efficient process. In fact this assertion is supported by Plume and Mitchell[62] who have demonstrated that virtual models—if provided with ample accurate information—will provide accurate results. However, their work also suggests that the level of accuracy required is much higher than typical design professionals usually work to and these more elaborate virtual models do not necessarily increase productivity. Resolving every detail virtually pre-construction implies construction is the assembly of predetermined components in a predetermined sequence. The suggestion being that construction is comprised of activities for assembly, devoid of any creative aspect.

1.4.2. Technology: Bias for the new

According to the twentieth century philosopher H. G. Gadamer our avid consumption of technology is a natural human prejudice in favour of the new.[63] Technological and software developments have become part of the organisational evolution of design and construction. Each new software version promises new and indispensable solutions. CAD was popularised in the design and construction industry during the 1980s. At that time it was used predominantly for drafting rather than sophisticated modelling or management tasks.[64] By the 1990s it had evolved to include 3D modelling capabilities and object oriented modelling (OOM) where smart

[61] "Pfi Construction Performance."

[62] For more on this see J. Plume and J. Mitchell, "A Multi-Disciplinary Design Studio Using a Shared Ifc Building Model" (paper presented at the CAADFutures, Vienna, 2005), pp. 449. For the counter argument on the problems caused by inaccuracies of 3D models, see chapter 2, section 2.3.

[63] Hans-Georg Gadamer, *Truth and Method*, ed. Garrett Barden and John Cumming, trans. William Glen-Doepel (London: Sheed and Ward, 1975).

[64] For more on this see Coyne et al., "Computers in Practice."

objects understood what they were and how they could relate to other objects.[65] In the late nineties virtual building software was emerging and promising self-generating documentation, quantities and schedules of information that would save time. Changes to any aspect of this data would automatically percolate through and update all the other data and documentation. Time management software was common in large organisations, with each member of staff filling in timesheets. This allowed an organisation to monitor the time and cost being invested in a particular project. However, CAD software was also emerging which could automatically track the time spent on projects and drawings.[66] Currently developments promise integrated BIMs and software such as JetStream that enables the combination of data from Structural, Architectural and Mechanical consultants. Such software informs each consultant of changes by the others and thus conflicts can potentially be resolved at the *virtual* stage of construction, leaving construction able to run as smooth as possible.

> JetStream collaborative design review software makes it easy to work effectively together and streamline your design review process. Providing a reliable way to communicate design intent and project information, with JetStream you can challenge, check and share design detail to improve and increase productivity.[67]

The quotation found above is from the press release of particularly sophisticated software called JetStream. On the website a short virtual walkthrough animation of a building model created from the information provided by the architectural, structural and mechanical design consultants. During this walkthrough it is possible to see virtual heating ducts intersecting with the virtual structure. The implication is that JetStream can assist with the identification and resolution of virtual conflicts before they become real and potentially problematic. It would seem

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[65] For example, early versions of AutoCAD would allow you to delete a window then you would have to repair the hole that it would leave in the wall. In the early 90's ArchiCAD was adopting the object oriented approach and when a window was deleted the wall from which it had been removed would automatic know to repair itself.

[66] SiaCAD, previously FastCAD based in Singapore were developing time management applications in the 1990s that would seamlessly integrate with the CAD application and record the time spent on individual drawings and projects.

[67] *Navisworks*, (Autodesk, [cited 15.06.07]); available from http://www.navisworks.com/en/jetstream.

the recurring promise of technology within the design and construction domain is to provide a structure or system that will relieve the user of mundane aspects of their work. Conflicts during construction can be time consuming, with no participant wanting to openly admit liability; these conflicts can cause delays and be litigiously contentious. It is assumed that these conflicts could be avoided through intensive scrutiny of the drawings or the virtual model. The implementation of technologies that expose virtual models to precisely this type of scrutiny—such as BIM applications—thus pre-empt these potential conflicts and delays can be expunged at a design stage before they arise during construction.

This trend in technological development perhaps implies two things; firstly, there is the prevailing assumption that it is possible to virtually represent the process of construction in some form. This reinforces the supposition that construction is the process of fabrication and assembly of a virtual representation. Secondly, the evolution of BIM software suggests construction can be managed by software, it will alert the participant to potential conflict and enable its resolution before it occurs. However, research by Peansupap and Walker[68] and also Ingirige and Sexton,[69] supports the claim that many initiatives based on the premise that technical intervention will resolve a particular problem usually fail to live up to their expectations within the design and construction domain.[70] McCarthy and Wright also challenge this supposition and argue in *Technology as Experience* that the self, not the technology should be centre stage.[71]

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[68] Dr. Vachara Peansupap and Professor Derek H. T. Walker, "Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations," in *ITcon* (2005), p. 193.

[69] Ingirige and Sexton, "Intranets in Large Construction Organisations: Exploring Advancements, Capabilities and Barriers."

[70] This may be partially due to at least some of these initiatives being based on perceived future needs of the industry. For more on this see Bowden et al., "Mobile ICT Support for Construction Process Improvement," p. 665.

[71] J. McCarthy and P. Wright, *Technology as Experience* (Cambridge, Massachusetts: MIT Press, 2004) p. 191-92.

1.4.3. Quality in design and construction

Within the manufacturing sector, which is often compared to the construction sector, quality control is an established part of the process. In the last two decades the design and construction industry has also implemented popular systems for monitoring the quality of procedures, the most widely adopted is the ISO (International Organization for Standardization)[72] accreditation however there are others such as BSC (Balanced Scorecard) system.[73] These systems of quality assurance are particularly visible within the document management aspect of the construction industry. While a systematic approach ensures documentation can be easily accessed, it is usually necessary to invest more man-hours in the process of recording and filing documentation to facilitate this access. This creates a dichotomy, as this type of quality systemisation as proposed by Egan requires additional man-hours and consequently can *increase* rather than decrease costs and time to complete construction, which conflicts with the underlying intention of Egan's recommendations. Quality audits are periodically carried out to assess an organisation's quality ISO system and accreditation, these are often preceded by substantial time being devoted to retrospective filing, ensuring the organisation appears to have been using the quality ISO system. The benefits gained from quality systemisation according to research by Ingirige, would seem to be gained through retrospective access to documentation as facilitated by the quality system or in the marketing opportunities of having such credentials.[74] There does not seem to be any

[72] *International Organization for Standardization*, (International Organization for Standardization, 2007 [cited 30.11.07]); available from http://www.iso.org/iso/home.htm.

[73] Amaratunga, Baldry, and Sarshar, "Process Improvement through Performance Measurement: The Balanced Scorecard Methodology."

[74] Quality systems and technological systems are occasionally used as a leverage tool for competitive advantage and for marketing a company's competitive advantage, for more on this see Ingirige and Sexton, "Intranets in Large Construction Organisations: Exploring Advancements, Capabilities and Barriers." Constructionline was also an initiative that promoted the use of its logo was a marketing tool to enhance a company's credentials. For more on this see Andrew Steele, Stephen Todd, and Dianne Sodhi, "Constructionline: A Review of Current Issues and Future Potential," *Structural Survey* 21, no. 1 (2003).

clear evidence that supports the suggestion that these quality systems benefit the actual process of construction.[75]

This section of the chapter has reviewed the effectiveness of changes to construction from recent initiatives. It has found that reorganisation through PFI and PPP—in individual cases—improved the efficiency of the construction process. However, there are questions surrounding the overall success of these initiatives, which at best would seem to be inconclusive. Technology is certainly perceived as an important component in the evolution of construction, and while developments such as BIMs are able to live up to their claims, these technologies may potentially limit creativity opportunities within the design and construction processes. They would almost certainly preclude the adoption of the popular design and build method of construction. Questions also remain surrounding the quality of the finished buildings, as well as the quality of the design and construction process. Which seems preoccupied with the quality of administration and additional structures for the recording of documentation. The evidence does not point to these activities benefiting the quality of the construction process but rather assists retrospective activities that require access to the documentation.

1.5. SUMMARY: SYSTEMISATION, TECHNOLOGY AND ARTISTRY

The aim of this chapter is to understand our contemporary description of the construction process. To do this we reviewed the legacy of a rule-based approach to construction, looked at recent initiatives that have promoted change in construction and finally discussed the effectiveness of those initiatives within the construction sector. In this final section of the chapter we draw together our findings and describe contemporary construction under the themes of *systemisation* and *technology,* and draw attention to the marginalised theme of *artistry* within construction.

[75] Some research suggests that while there are many attempts to introduce systemised procedures into working practices, there is a low take-up of these systems. For more on this see F.T. Edum-Fotwe, A.G.F. Gibb, and M. Benford-Millar, "Reconciling Construction Innovation and Standardisation on Major Projects," *Engineering, Construction and Architectural Management* 11, no. 5 (2004).

1.5.1. Systemisation: from Vitruvius to BIMs

The historical context of design and construction has promoted the development of rule-based systems for organisation and execution. Arguably, the very process of building and ordering the environment is a form of systemisation, so it is perhaps natural for this theme to dominate. Systemisation has been shown to be closely associated with notions of quality and within the construction sector technology has presented new opportunities for this. As we have explored the evolution of construction we have found rule-based systems appropriated as a means to assure quality throughout its history; from the ancient rules of Vitruvius through the pattern books[76] of the eighteen and ninetheenth century to current software systems. The more recent developments of the last hundred years see systemisation and standardisation continue to have a high profile in the development of the design and construction sector. Currently computing technologies such as BIMs provide the base upon which new methods of systemisation for construction processes will be built, and MMC also continue to increase the rigidity in both the design and construction processes.

In The Ten Books on Architecture Vitruvius claims to establish rules for creating buildings. However, Vitruvius implies there is perhaps more to design and construction than rules, "for in the following books I have disclosed all the principles of the art."[77] In what is arguably the first architectural and construction manual, in which the rules for achieving quality of construction dominate the discourse, there is subtle acknowledgement of the artistry of these processes. Unsurprisingly Vitruvius does not distinguish between the science of rule-based construction and the artistry of the process,[78] as the artistic/scientific strands of design and construction only began to noticeably diverge after the Enlighten of the seventeenth and eighteenth

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[76] Rawlins, *Familiar Architecture; Consisting of Original Designs of Houses for Gentlemen and Tradesmen, Parsonages and Summer Retreats.* Also see *British Small Towns from the 16th-19th Century*, (University of Leicester, 2007 [cited 30.11.07]); available from http://www.le.ac.uk/ur/resources/smalltowns/appendices.html#pattern.

[77] Vitruvius Pollio, *Vitruvius the Ten Books of Architecture* p. 4.

[78] Pre-Enlightenment there is less distinction between art and science. The Latin *ars* is the word from which the modern term *art* is derived. Historically ars means art, skill and craft, the phrase does not distinguish between what we would now refer to as art and science. Also the phrase *poiesis* meaning creation, production and poetry blends together the notion of art and production.

century. The stonemasons and plasterers that we referred to, as well as reproducing also improvised and modified their patterns when circumstances demanded. Although the themes of systemisation and standardisation are clearly dominant within the historical and contemporary descriptions of construction, artistry, albeit overshadowed also runs through them.

1.5.2. Technology, science and misdirection

Since the Industrial Revolution the role of engineering and science has played an important role both in improvements to quality of life in the form of mass production and also in expanding the possibilities of what can be constructed. Technological developments have been instrumental in many iconic buildings of the twentieth century, from the roof of St Pancras Station in London to the Sydney Opera House in Australia. While material technology and engineering has been key in the construction of these buildings, they are iconic and arguably stand out historically because the strands of art and science have perhaps momentarily converged within their construction. Technology is not exclusive to the realm of the sciences, we see it implicated here within the artistic and the emotional senses as well. McCarthy and Wright[79] support the claims that human emotions and senses are involved with our experience of technology, which challenges its scientific framing and theorising. Heidegger suggests emphatically if we are to critique technology it should be from the aspect of art:

> Because the essence of technology is nothing technological, essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it. Such a realm is art. [80]

He is critical of attempts to critique technology as simply functional technology. Rather than simply a means to an end, Heidegger argues that we enter into a relationship with technology, thus suggesting there is a complexity to activities that engaging with technology beyond the simple provision of additional

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[79] McCarthy and Wright, *Technology as Experience* p. ix.

[80] Martin Heidegger, *The Question Concerning Technology, and Other Essays*, trans. William Lovitt, *Harper Colophon Books* (New York; London: Harper and Row, 1977) p. 35.

functionality. In this respect to interrogate technology within construction, construction should be considered as an artistic process rather than a technological one. According to Yessos BIM software has proved successful, however its success relies on a description of a building that the software can understand. At the time of writing this is limited to geometrically simple and rectilinear built forms. Although technology often fulfils its functional remit, it may limit the creative possibilities or unexpectedly restrict activities within design and construction processes.

1.5.3. Artistry within Construction

The dominant contemporary description of construction is one where the artistry within the construction process is overshadowed by systemisation. Construction is predominantly described in the functional terms of fabrication and assembly. These artistic aspects is absent from the current description of construction and although the notion of construction as *techné*[81] has been overshadowed by construction as *technical*, we claim that while the artistic has been diminished within the dominant description of contemporary construction they remain present and intrinsic to the process.

The contemporary description of construction has been revealed as one where functional aspects of fabrication, assembly and coordination dominate and the arcane aspects of artistry and creativity are marginalised. Technology features within this functional framework and the influence of technological interventions are considered in terms of their functional affordances. Little consideration is given to the influence exerted upon relationships and other non-functional aspects of the construction process by the appropriation of new technologies. The construction sector envisions construction as logical linear processes of design followed by construction. It is believed that increasing the rigidity of these linear processes will increase the efficiency of the process. If we subscribe to the construction sectors logic then increasing systemisation should increase quality and the findings of this chapter suggests it does not. Within this contemporary description computing technology is

[81] Translated as either craft or art. Richard Parry, *Episteme and Techne* (Stanford Encyclopedia of Philosophy, 2007 [cited 29.07.08]); available from http://plato.stanford.edu/entries/episteme-techne/.

almost exclusively considered as a tool to increase rigidity and systemisation. Although mobile phones would seem to be an influential technology and widely used within construction, as this chapter attests they do not feature as frequently as might be expected within the literature and within the description. This calls into question the effectiveness of current models for understanding the relationship between participants, technology and construction process, and adds currency to McCarthy and Wrights line of reasoning that calls for richer models to understand human computer interaction.[82]

Having documented the contemporary description of construction, the following chapter will focus on reviewing current research in this domain. It will assess if this contemporary description exerts influence upon research and review the body of knowledge to which this thesis will contribute.

[82] McCarthy and Wright, *Technology as Experience* p. 189.

2. CURRENT RESEARCH

> Standardise and you simplify lives: everyone learns the system only once. But don't standardise too soon; you may be locked into a primitive technology, or you may have introduced rules that turn out to be grossly inefficient, even error inducing.[83]
>
> The system's designers have thought in terms of what the machine might be able to do, and once having devised these machines functions, the human functions thereby have been implicitly allocated by omission.[84]

2.1. INTRODUCTION

The previous chapter documented the legacy of a rule-based approach to construction. The contemporary description of construction that emerged revealed a functional and logical conception of construction was prevalent and construction is widely conceived as a series of linear fabrication and assembly processes. This chapter will focus on reviewing current research that is centred on communication technology and its influence within the design and construction processes. The scope of this chapter will not be limited to mobile phones; the terminology *communication technology* is used here very broadly to encompass phones, drawings, CAD sketches etc. The aim of this chapter is to determine if the contemporary description of construction established in chapter one influences current research and review the body of knowledge to which this thesis will contribute to determine the extent to which current research has investigated the influence of communication technology on creative processes. In so doing this chapter will help identify opportunities within the research for further investigation.

This chapter will review the current research under the themes of *reorganisation*, *technological intervention* and *collaboration*. The boundaries between the themes are indistinct and many of the research projects that are cited in this chapter are not exclusive to one theme or another, they may be implicated within a combination of the themes.

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[83] D Norman, *The Psychology of Everyday Things* (New York: Basic Books, 1988) p. 202.

[84] Nigel Cross, *The Automated Architect* (Viking Penguin, 1977).

Taking the first theme of *reorganisation* and considering the opening provocation by Norman we review work that addresses process standardisation within construction and ask are such initiatives—in Norman's words—"grossly inefficient, even error inducing?" In the second theme, *technological intervention*, we reflect on the opening provocation by Whitfield and interrogate the effects of technological insertion on human function, focusing on the implication on participants' working practices within construction. Finally in the third theme of *collaboration* we focus on research that concentrates on improving collaboration within construction, this is usually achieved by implementing a combination of strategies drawn from the first two themes.

2.2. REORGANISATION OF CONSTRUCTION

Chapter one explored initiatives aimed at reorganising construction by adopting a manufacturing management structure, anticipating that construction would see similar improvements in productivity and efficiency. This section takes a more detailed look at current research that is focusing on improving these aspects of construction through reorganisation. Firstly to provide a context for the reorganisation of construction we look at existing organisational models for construction and assess their effectiveness.

2.2.1. Existing models

The dominant model for construction in the UK is the Royal Institute of British Architects (RIBA) Plan of Work[85] as illustrated in Figure 2.1. This plan sub-divides design and construction into four general parts: Briefing; Sketch Plans; Working Drawings and Site Operations. This is further divided into the twelve stage linear plan known as the Plan of Work (PoW). This breaks down the design and construction process into a series of stages from (A) Appraisal through to (M) Feedback. While it is acknowledged within the Architects Job Book that these stages may overlap, it is implied both by its diagrammatic representation and by its linear published form that the PoW is a compartmentalized linear sequential process.

[85] Taken from Stanley Cox and Alaine Hamilton, *Architect's Job Book*, 6th ed. ed. (London: RIBA Publications, 1995).

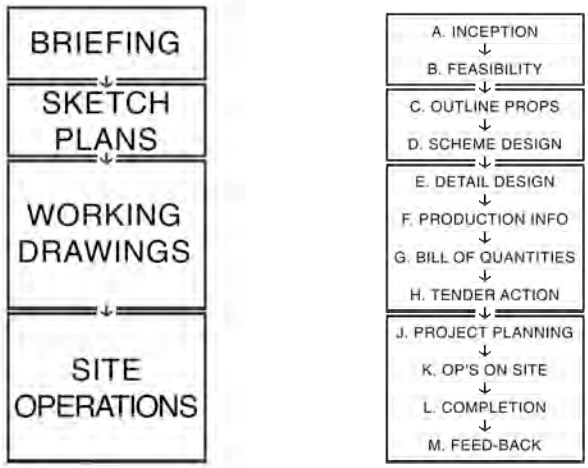

Figure 2.1 The RIBA Plan of Work: The construction sectors dominant organisational model

The Plan of Work was first published in 1964 and has changed little in the intervening period. In 1999 it received its most substantial revision to date, which reflected the difficulties of slavishly following the PoW in contemporary construction. Even so, Chappell still contests that it continues to be difficult to define precisely when a project progresses from one stage to another.[86] The PoW still underlies construction and is the foundation on which both the business and processes of design and construction are based.[87] Architectural fees are payable upon completion of certain stages of the PoW, and architects—during their professional training—are also schooled in the Plan of Work and its understanding is seen as fundamental to the managing of the design and construction of a building project. The Plan of Work is a creation of the RIBA and it has been suggested by Lawson that it represents a model for the production of documentation for design and construction rather than a model for the actual design process.[88] Lawson even goes

[86] For more on this see David Chappell and Andrew Willis, *The Architect in Practice* (Malden: Blackwell Publishing, 2005).

[87] It is perhaps surprising the RIBA PoW has resisted change so long given the popularity of Design/Build and Partnering procurment routes.

[88] Bryan Lawson, *How Designers Think: The Design Process Demystified*, 4th ed. (Amsterdam; Oxford: Elsevier Architectural Press, 2006) p. 36. For more on the importance given to documentation during construction see C.P.I.C, *Production Information: A Code of Procedure for the Construction Industry*, 1st ed. (UK: Construction Project Information Committee, 2003).

so far as to suggest the PoW is the architectural profession's "propaganda exercise to stake a claim as leader of the multi-disciplinary building design team,"[89] rather than a tool to facilitate the process of construction.

Whatever the underlying motivation for the Plan of Work is, it remains the foundation on which the process of contemporary construction is built. Methods for the procurement of building projects such as design and build etc. have been constructed over the Plan of Work, and recently developed procurement methods such as PFI and Partnering—as discussed in chapter one—are also constructed over this foundation. The PoW underpins many of the sanctioned and legally binding JCT contracts[90] used during construction and thus underpins the business of construction.

The motivations behind the RIBA PoW not withstanding it has proven to be a very useful organisational tool. It enables participants within a construction project to orientate their design and construction activities and relate their role and responsibilities to the responsibilities of other groups and individuals within the construction process. This is of considerable importance in a process as complex as a construction, which can take months or even years from inception to completion and can include hundreds of participants, many of whom need to coordinate closely and may only be on a construction site simultaneously for a short period of time. The PoW provides a foundation for the planning and sequencing of materials and skills, which are required on construction sites at very specific points in time and space. To these ends it should be noted that the Plan of Work is an important and valuable organisational tool for the construction process.

Lawson has investigated the effectiveness of the RIBA Plan of Work as a model for the design and construction process. In *How Designers Think* many celebrated architects are interviewed about how they design and construct, the results

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[89] Lawson, *How Designers Think: The Design Process Demystified* p. 36.

[90] Dominant form of contract used in UK is published by the Joint Contracts Tribunal (JCT) and are know as JCT contracts. http://www.jctltd.co.uk/

of these interviews suggest that adherence to the current RIBA PoW model is not necessarily a prerequisite for success.[91]

Having interviewed architects with regards to their creative process, Lawson challenges the established RIBA PoW model, and illustrates a variety of esoteric systems—far removed from the RIBA PoW—which are practiced by participants involved in design. Lawson demonstrates that this subversion of the RIBA PoW does not have any adverse effects of the execution of the design and construction processes. The RIBA Plan of Work illustrated in Figure 2.1 sets out that the Outline Proposal stage will be followed by the Detailed Proposal stage. However, as noted by Lawson, architects Eva Jiricna and Robert Venturi occasionally work in reverse, starting with the Detail Design stage and working in reverse towards to the Outline Design[92] without negatively influencing the overall organisation and execution of the construction process. There are also examples involving Carlos Scarpa where his design process begins by drawing inspiration from the construction method out of which his construction detail emerges.[93] However, there are also less elite examples of alternative construction methodologies that challenge the ubiquitous RIBA PoW, for example Design and Build, which continues to be advanced by the likes of Tom Woolley.[94] The Plan of Work unarguably assists the organisation of construction and is a useful model for the design and construction process, but it is clear from Lawson's research that the application of the PoW model is not necessarily intrinsic to the organisational success of the process. There are schools of thought that contest this position; the likes of Wachsmann argue if systemisation is to be embraced it should be all-encompassing:

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[91] Eva Jiricna and Robert Venturi both place a great level of importance on the detailing of a design and work in what some would describe as a backwards manner where the general design is driven by the details. For more on this see Lawson, *How Designers Think: The Design Process Demystified* p. 39.

[92] Ibid.

[93] Bryan Lawson, *What Designers Know* (Oxford: Architectural, 2004) p. 48-49.

[94] Woolley, *Natural Building : A Guide to Materials and Techniques*.

> The industrialised process can only have its full effect within a system of all pervasive order and standardisation.[95]

The contemporary description of construction that emerged from chapter one would seem to suggest the construction industry subscribes to Wachsmanns' school of thought. While there are—as we have discussed—benefits to using a model or system to assist orientation, as suggested in the opening quote by Norman, systems can also be problematic. An abstracted model of a complex task may only serve to misrepresent that task, or it may—as Norman suggests—have inherent errors and thus adversely affect the task that it was conceived to somehow help. Donald Schön has perhaps best described this as *generative metaphor*.[96] Whereby the metaphorical description of a particular situation or problem influences the set of solutions that may be generated to address that situation or problem. McCarthy and Wright are also uneasy regarding conceptualising through metaphor.[97] They argue that doing so will bring some phenomena to the centre while others will be marginalised. In the following sections we shall bring evidence to bear that supports this and the claim made by Brown and Duguid, which alleges that technology and procedure often takes centre stage within these new models and human interaction and working practice are marginalised.[98] When an inappropriate metaphor is chosen it can cause the problem to degenerate into what Rittel and Webber describe as a *wicked problem*[99] and become unsolvable. Consequently, an inappropriate description of construction could have a similar effect and influence how we go about restructuring it.

For a moment we will turn our attention to the domain of computing system implementation, where there is more discourse regarding the influence of

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[95] K. Wachsmann, *The Turning Point of Building* (1961).

[96] For more on this see Donald Schön, "Generative Metaphor: A Perspective on Problem-Setting in Social Policy," in *Metaphor and Thought*, ed. Andrew Ortony (Cambridge: Cambridge University Press, 1979).

[97] McCarthy and Wright, *Technology as Experience* p. 188.

[98] J.S. Brown and Paul Duguid, *The Social Life of Information* (Boston: Harvard Business School Press, 2000) p. 92-94.

[99] For more on this see H Rittel and M Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973).

technological systemisation on working practices. Veen illustrates how computing systems can be conceived and reorganised to retain the integrity of the creative process they are used for.[100] However, he attaches substantial importance to the system designer being able to understand that process. Kling has interrogated system implementation from a sociological perspective and reveals covert political reasons can often be an influence on systemisation.[101] Kling cites case studies where individuals in large organisations use systemisation and standardisation as vehicles to achieve personal promotion rather than for actual process improvement. Within the domain of design and construction Bijl has contested this drive toward systemisation and advises:

> Our perceptions of tasks may be conditioned by an intention to represent them in a computer, which will cause us to see only those things that we believe we can represent and filter out all else. The designer who is performing a task, with no anticipation of it operating within a computer, is likely to have quite a different perception of what he or she is doing.[102]

Tweed has also reflected on the complexities and inherent difficulties in the systemisation of collaboration, suggesting:

> We must be careful not to underestimate the problems inherent in designing and building such systems. Before we can do so we need a much deeper understanding of how interactions will take place generally within groupware systems.[103]

Where our intention is to transfer the responsibility of such nuanced and esoteric practices to computing devices, we are continually urged to proceed with caution. This suggests that where communication technologies are adopted into a process they may be unexpectedly influenced by unanticipated causal relationships. There is research that challenges the drive for all-encompassing systemisation; the author—in collaboration with Lee—has drawn from the cognitive sciences, where in

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[100] Jeffrey Veen, *Why Content Management Fails* (Adaptive Path, 2004 [cited 01.04.04]); available from http://www.adaptivepath.com/publications/essays/archives/000315.php.

[101] Rob Kling, *Computerisation and Controversy: Value Conflicts and Social Choices*, 2nd ed. (San Diego: Academic Press, 1996).

[102] Bijl, *Computer Discipline and Design Practice: Shaping Our Future* p. 69-70.

[103] Chris Tweed, "Supporting Argumentation Practices in Urban Planning and Design," *Computing, Environment and Urban Systems* 22, no. 4 (1998): p. 362.

the absence of systemisation small groups of participants have been shown to generate their own esoteric systems and language for describing and solving problems.[104] These esoteric systems can be more efficient than general imposed systems. However, they may make inter-group communication more difficult and thus could become problematic within complex processes—like construction—which rely on extensive inter-group communication.

Nevertheless, the findings in this section present a challenge to Wachsmann's assertion, and reinforces the supposition that systemisation does not need to be all-pervasive. Cited examples have illustrated how skilled professionals can breakaway from systems like the RIBA Plan of Work without causing catastrophic failure in either the organisational system or its ability to fulfil its organisational function. The creative design solutions of Scarpa, Jiricna and Venturi show there is value in facilitating fluidity within these systems.

2.2.2. New models

Having looked at existing models for the organisation of design and construction, we now turn our attention to new approaches for reorganising design and construction. Koskela and Vrijhoef have reviewed a typology of remodelling[105] within current research. They expose two dominant strategies that we will discuss in turn. Firstly, we will explore the strategy of *mapping,* where an organisational model is appropriated from one domain and applied to another. Secondly, we will explore the strategy of *change reduction,* this is a theme prevalent in much of the current research and aims to create more accurate descriptions of designs before the translation into buildings. These strategies are not necessarily mutually exclusive, and examples will be discussed where these strategies overlap. Lawson reviews the history of mapping and modelling of design and construction practices;[106] he combines these models with his own evidence and suggests that design and

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[104] John Lee and Dermott McMeel, "'Pre-Ontology' Considerations for Communication in Construction," in *Ontologies for Urban Development* ed. J. Teller, J. Lee, and C. Roussey, *Computational Intelligence* (Verlag: Springer, 2007).

[105] Koskela and Vrijhoef, "Is the Current Theory of Construction a Hindrance to Innovation."

[106] For more on this see chapter two of Lawson, *How Designers Think: The Design Process Demystified.*

construction are not linear. In a challenge to the ubiquitous PoW model Lawson suggests design and construction is a combination of cyclical and iterative processes. Lawson suggests processes of *analysis*; *synthesis* and *evaluation* exist between the design problem and the design solution.

As discussed in chapter one a popular domain from which to map processes into construction is the manufacturing sector. Although Koskela and Vrijhoef argue this is not conducive to the development of the construction process[107] the sector continues to appropriate process models from other industries. Rajat Roy has documented the appropriation of such a process and its application to the construction domain in the form of the *Process Document.*[108] The aim if this Process Document is to "improve communication on quality standards, encourage teamwork, and deal effectively with information on product variants."[109] Within this model the *process document* becomes the primary mode of communication for drawn information and it includes quality and construction method information. This model then proposes to standardise not only the documentation but also—by seeding the process with selected information—to standardise the method of the construction process by which any tradesman might execute the work. This and other strategies[110] emerging from the research resonate with the dominant description of construction as a functional assembly process.

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[107] For a more detailed elaboration on this argument see Koskela and Vrijhoef, "Is the Current Theory of Construction a Hindrance to Innovation."

[108] The Process Document is not seen as a replacement for e-mail, fax, etc. it is seen in this context as the primary mode for communicating drawn information.

[109] Rajat Roy, Margaret Low, and John Waller, "Documentation, Standardization and Improvement of Construction Process in House Building," *Construction Management and Economics*, no. 23 (2005): p. 58.

[110] For further reading on this see Chris Fortune, "Process Standardisation and the Impact of Professional Judgement on the Formulation of Building Project Budget Price Advice," *Construction Management and Economics* 24, no. 10 (2007). Sebastian Macmillan et al., "Mapping the Design Process During the Conceptual Phase of Building Projects," *Engineering, Construction and Architectural Management* 9, no. 3 (2002).

However, the COLA and B-Hive research projects take a different approach and apply knowledge management[111] (KM) initiatives to construction. These initiatives draw from established KM models found in other sectors and apply them to construction. These projects propose strategies that promote the retention and dissemination of knowledge within construction through the implementation of Knowledge Management (KM) strategies.[112] This approach aims to establish organisational models that reduce knowledge loss during construction, so that future construction projects can potentially avoid past problems re-emerging. The COLA and B-Hive models entail workshops that involve the different participants as a project nears completion. This can require substantial coordination as many of the participants will have completed and moved to other construction projects. These workshops have met with scepticism; the competitive nature of construction means knowledge sharing between organisations is not common practice. Yet Cushman reports that results of these initiatives when such organisational and cultural obstacles have been overcome have been positive[113] and several large construction organisations have integrated KM strategies into their plan of work as projects near completion. Unlike the Process Document, these methods at least acknowledge the possibility of embodied knowledge within roles and working practices. A proposition that is further strengthened by empirical studies carried out at Xerox and subjected to considerable scrutiny by Brown and Duguid.[114]

Other mapping strategies focus on greater design resolution during pre-construction, the presumption being when construction starts there will be a minimal amount of deviation from the organisational plan, thus minimising potential conflicts

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[111] A widely accepted definition of knowledge remains elusive particularly regarding its isolation and externalisation, which are critical within discourse intent on its representation within computer systems. For a more philosophical reflection on knowledge see Bijl, *Ourselves and Computers*.

[112] Abduk Samad Kazi, ed., *Knowledge Management in the Construction Industry: A Socio-Technical Perspective* (Idea Group Publishing, 2005) p. 139.

[113] Mike Cushman and Tony Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach," *International Journal of IT in Architecture* 1, no. 1 (2003).

[114] In cited examples, because of experience, people are able to identify errors that technology cannot. For more on this see Brown and Duguid, *The Social Life of Information* p. 78-81.

and delays. Process Protocol proposed by Kagioglou[115] is one such strategy, which provides a framework that encourages more design resolution during pre-construction and more coordination between designers, clients and contractors. However returning to Lawson's supposition that the RIBA Plan of Work is attending to documentation, additional pre-construction co-ordination will potentially only resolve documentation and have limited influence on the eventualities that arise when construction begins.[116] Consequently it may not necessarily deliver the anticipated benefits to the construction process.[117] Norman's opening provocation causes us to consider systemisation and the problems that might be inherent within it. If the RIBA's PoW is biased towards document production, this potentially limits the effectiveness of any extensive pre-construction resolution, as it will be resolving abstracted documentation and not design ideas.

In the words of Bijl, construction documentation[118] is "to convey perceptions in the mind of designers in an externalised form that representations of which can be seen by other people."[119] This abstraction helps to facilitate communication during construction through general syntactical standards enabling different groups of participants to communicate and coordinate. However, according to Schön this process of abstraction creates an unreal description and this invites interpretation by

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[115] For more on this see M Kagioglou et al., "Rethinking Construction: The Generic Design and Construction Process Protocol," *Engineering, Construction and Architectural Management* 7, no. 2 (2000). Also see M Kagioglou, R Cooper, and G Aouad, "Performance Management in Construction: A Conceptual Framework," *Construction Management and Economics* 19 (2001). The BSC (Balanced Scorecard) system which is mapped from business practice as discussed by Amaratunga, Baldry, and Sarshar, "Process Improvement through Performance Measurement: The Balanced Scorecard Methodology." Enterprise Engineering is also mapped from the business sector and discussed in Mohammad Arif et al., "Enterprise Information Systems: Technology First or Process First?," *Business Process Management* 11, no. 1 (2005).

[116] Lawson illustrates elsewhere that what he terms "outstanding designers" actually make quite small drawings on small sheets. Implying successful communication is not exclusively reliant on quantity of information. See Lawson, *What Designers Know* p. 55-57.

[117] This could also been seen to be the view supported by builders and tradesmen in practice. In Appendix A.2, interview 10 the interviewee felt that there is already enough documentation. They suggested that certain aspects of design resolution are only addressed when—particularly the clients—see the building taking shape on site.

[118] We are referring to documentation such as drawings, bills of quantities, schedules and gant charts.

[119] For a thorough analysis of design documentation see Bijl, *Computer Discipline and Design Practice: Shaping Our Future* p. 143.

the participants within the construction process. This is perhaps a general flaw inherent in metaphorical models and specifically in the RIBA PoW model, which underlies and thus undermines new models that are mapped onto it. This abstraction can also make the reading of such documents problematic, particularly for participants such as the clients who are not part of the design and construction culture and consequently are not fluent in this specialised descriptive language. While this form of specialised communication can isolate clients from the construction process, the Egan and Latham Reports suggest they are the most important participants, whether or not a building is often considered successful, is based on the fulfilment of the clients' requirements.

Other modelling strategies have emerged as software and computing have increased in power. The *virtual building* and *virtual construction* have come into view as viable organisational models for the design and construction process. They enable construction documentation to be represented not only as abstract graphical schematics but also in a tangible visual form. Software that subscribes to this notion attempts to translate a building design into a form that is easier for participants—such as clients—to understand. The pursuit then of a completely unified virtual model of a building before it is constructed, would in principle seem very useful. However, it also beholden to limits imposed by the underlying PoW model and communication through abstracted documentation. This aspect of construction organisation will be discussed in greater depth in the following section 2.3 Technological Intervention.

In this section we have discussed current research strategies that aim to improve the construction process through reorganisation. The predominant goal throughout these strategies is the removal of ambiguity in the design, documentation or execution of construction. We have discussed KM Strategies that have been deployed in actual construction projects such as the COLA project, which has received positive results. However, this research acknowledges the impositions of limits by the underlying competitive nature of the existing construction culture. Knowledge Management initiatives are reliant on the sharing of knowledge, but existing models of construction are based on competitive tender and sub-contracting

that promotes knowledge hording to maintain a competitive advantage and not knowledge sharing.

Improvements to the construction process through reorganising would seem to be restricted by the underlying RIBA PoW model. We have invoked Schön, Brown and Duguid to highlight the adverse consequences of abstract modelling and conceptualising. As an organisational model the RIBA PoW brings documentation to centre stage and marginalises the process of construction and the working practices that it comprises. As it underpins the business and organisation of the design and construction process, it limits the influence of any of the alternative organisational models that have been discussed as they are built upon it. Traditional abstracted paper-based construction documentation has a legal and contractual role within the construction process, and increasingly accurate virtual descriptions of buildings—no matter how accurate—will continue to be translated into traditional abstracted paper-based documentation that invites interpretation and pushes tacit knowledge that reside within on-site working practices to the periphery.

2.3. TECHNOLOGICAL INTERVENTION

This section will discuss current research that seeks to achieve improvements in productivity and efficiency within construction through technological intervention. Mobile phones are perhaps of particular interest here as they have been adopted by many participants within construction, whereas other technologies often fail to achieve such wide spread usage.[120] Firstly in this section we discuss the cult of the *must have* in terms of technology and reflect on the culture of consumption concerning technology within construction. Secondly we will review the influence of *proprietary devices*, designed specifically for roles within construction. Thirdly we will review the *technological focus* of interventions across the roles within construction.

[120] For more on this see Peansupap and Walker, "Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations." Also see Bowden et al., "Mobile ICT Support for Construction Process Improvement."

2.3.1. 'Must Have' applications

The Computer Aid Design (CAD) software of the 1980s that represented designs visually. Current Building Information Model (BIM) software represents design information and is rapidly becoming the must have application. Both software developments leave considerable room for improvement, but promise substantial benefits if they are adopted within design and construction practice. Tweed claims that constant room for improvement means we will be quick to snap up the new version.[121] CAD applications claim to ease document production and reproduction, as well as assist with collaboration through standards[122] for the exchange of this digital information. However, Kling—as we have discussed previously in this chapter—has suggested there may be other non-functional but political motivations, such as promotion behind technological implementation.[123] Within the design and construction sector Coyne et al. have reported peer pressure[124] as being an influential factor in the adoption of CAD by architectural practices. This supports the claim made by Bijl that architects adopt CAD to stay abreast of competitors as well as its functional benefits.[125]

Historically, modernisation has actually been shown to cause a slump in productivity at a national scale, and the introduction of computers has also caused economic disruption.[126] While there may be unexpected 'cause and effect,' at a local scale the adoption of CAD software has had documented benefits.[127] CAD enabled more work to be undertaken by fewer people, and Coyne shows that larger and more complex construction projects—which had previously been out of reach of smaller

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[121] Tweed, "The Social Context of Caad in Practice."

[122] Standards such as Drawing eXchange Format (DXF) and AutoCAD's standard Drawing (DWG) format.

[123] For more on this see Kling, *Computerisation and Controversy: Value Conflicts and Social Choices.* Also see Rob Kling and S Iacono, "The Control of Information Systems Developments after Implementation," *Communications of the ACM* 27, no. 12 (1984).

[124] For more on this see Coyne et al., "Computers in Practice," p. 9.

[125] Bijl, *Computer Discipline and Design Practice: Shaping Our Future.*

[126] Brown and Duguid, *The Social Life of Information* p. 83.

[127] We must also acknowledge that the adoption of technology might influence working practices negatively. For a philosophical perspective on questions regarding the adoption of computers see Bijl, *Ourselves and Computers.*

practices—were becoming within their reach when they invested in CAD applications. By the 1990s as CAD increased in complexity and computing hardware increased in power, CAD applications furnished with correct information and could produce *virtual model*s that would be able to automatically generate construction documentation. These tools continue to generate reflection on their influence upon the design process.[128] As the virtual model was changed the documentation would be updated automatically by the CAD software, thus removing the need for individual drawings to be laboriously modified. As more information can be processed by CAD applications it can be appropriated within the software for a variety of different functions. For example Roofmaker is an application integrated into the ArchiCAD[129] software, which will generate a roof structure[130] as illustrated in Figure 2.3 from a roof object as illustrated in Figure 2.2.

Figure 2.2 ArchiCAD modelled roof object

[128] More recently André Brown has reflected on the influence of CAAD on visualisation, representation and design process, see A Brown, "Visualisation as a Common Design Language: Connecting Art and Science," *Automation in Construction* 12 (2003).

[129] For more on this see http://www.graphisoft.com

[130] To do this you must provide information about the size and spacing of rafter, ties etc. It remains to be seen how practical this is as a construction tool as the generated solution lacks joinery and carpentry intelligence, but might perhaps be beneficial in a quantitative sense. However as we have elaborated on elsewhere the inclusion of such information can take on misleading authority by its presence, whether it is accurate or not.

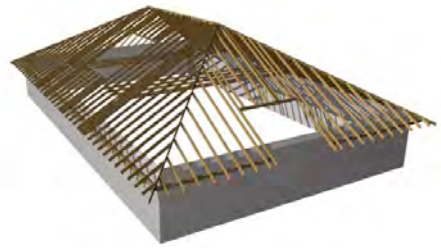

Figure 2.3 ArchiCAD automatically generated structure

Applications have also emerged to assist with organisational planning, project management applications such as NavisWorks[131] will generate organisational Gant charts, illustrating a construction project's timeline and the different building elements such as ground-works, foundations, ground floor slabs, walls, etc. Included in this chart are the complex interrelations of these numerous elements. If the second floor walls were delayed by two weeks within a construction project, and this information is updated within the project management application it will be able to show the effect on the scheduling of the subsequent construction timeline. Research by Plume and Mitchell suggests adding functionality to CAD applications either requires the CAD model to be more precise or requires the provision of additional information within the model. Both the virtual modelling software and the organisational software rely on additional information, this can be problematic as additional information may not be available, either because time restrictions prohibit the inclusion of all the necessary information or the required information is not available. Plume and Mitchell show that individuals who create the model may not habitually include all this information or work to the precise tolerances required by new software applications.[132] It does however support the thesis that these software

[131] For more on this see http://www.navisworks.com

[132] During the research project it was decided to re-model the building due to inaccuracies and inconsistencies that were proving problematic for the software to resolve. For more on this see Plume and Mitchell, "A Multi-Disciplinary Design Studio Using a Shared Ifc Building Model".

applications will produce reasonably accurate results if they have been provided with accurate information.

Other software applications are being explored and research by DeVries and Harink has investigated simulating the construction process[133] using virtual models. This is occasionally referred to as *4D* modelling, and is achieved by software being programmed to make assumptions regarding the sequence in which elements within the virtual model will be assembled during construction and then apply some temporal rules to those elements.[134] Like Plume and Mitchell's findings, this research also suggests that if software is provided with accurate information it will generate reasonably accurate results. However, both these research projects suffered because of inaccuracies in the virtual models,[135] in both cases it was necessary to re-build the virtual model from scratch to obtain accurate results. The inaccuracies in the virtual model were partially due to the inclusion of information at the design stage that was not accurately represented. For example, a table within one virtual model was assigned a wooden finish, however it had also been assigned a concrete structure. Within the designers' virtual description the pinewood finish of the table was important, the concrete material assigned to the structure was of no consequence within the designers' description other than that the software requires an assigned material. The 4D construction application that used the designers' virtual model description to generate a construction sequence appropriated this information for its calculations. The projected timeline included several additional weeks to make the concrete furniture. Although this example may appear anecdotal, as illustrated by

[133] Bauke DeVries and Jeroen Harink, "Construction Analysis During the Design Process" (paper presented at the CAADFutures, Vienna, 2005).

[134] For example a certain volume of concrete can be poured in a particular timeframe. Then it must cure for a certain amount of days before any elements on top of it can be assembled.

[135] Other research has also found the accurate construction of 4D models time consuming, see Ali Murat Tanyer and Ghassan Aouad, "Moving Beyond the Fourth Dimension with an Ifc-Based Single Project Database," *Automation in Construction* 14 (2005). In this example the authors reflect on too much detail where it was not required and not enough detail where it was required. Another example is Ting Huang et al., "A Virtual Prototyping System for Simulating Construction Process," *Automation in Construction* 16 (2007). Where tower cranes and scaffolding were integrated into the 4D model.

Figure 2.4 a table object description is quite complex and can contain elaborate information.

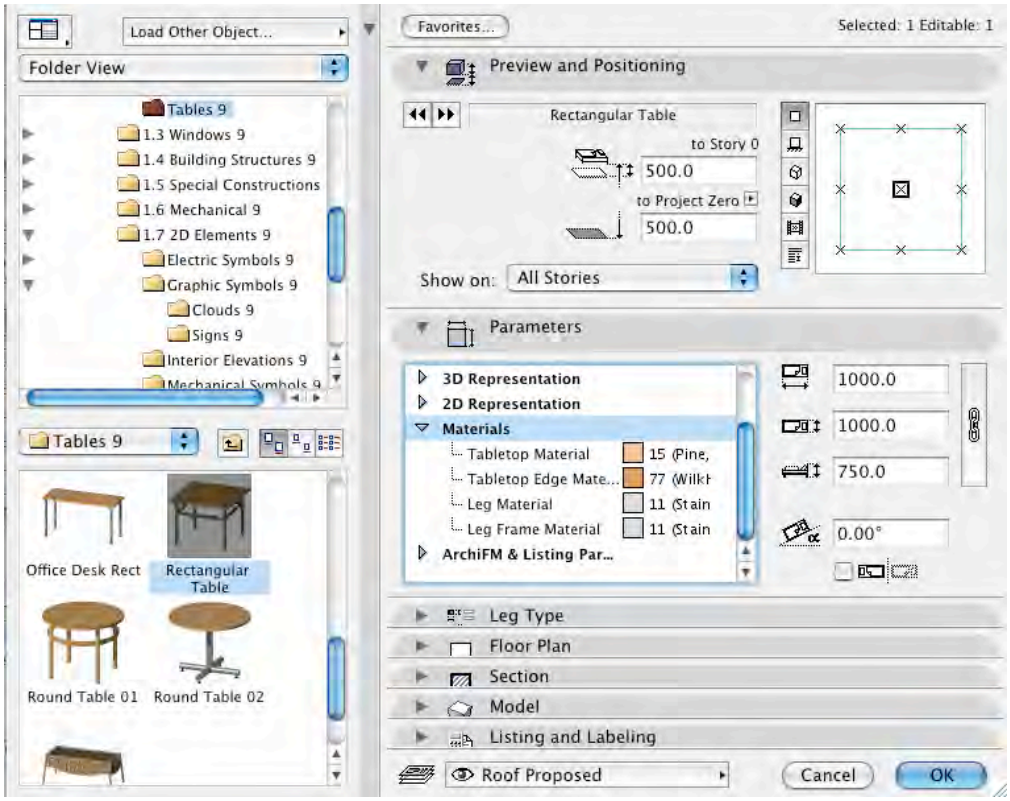

Figure 2.4 Complexity of a CAD virtual table description

These Building Information Models (BIMs) also provide a framework to integrate different building information models from different consultants (structural, mechanical, architectural etc.) in a single unified model. The BIM application then relieves any single consultant from the burden of providing all the information for a particular application. BIM applications can potentially identify conflicts between the different information model descriptions and inform the relevant consultant of these conflicts during the pre-construction stages of the project. During construction a design will evolve as the respective information models are updated in the BIM application, which can identify potential conflict within the model and prompt the participants to resolve these *virtual* conflicts before they become *real* conflicts. It is perceived that when conflicts become real they become more problematic to resolve. Early conflict identification and resolution has the potential to benefit the efficiency and productivity of the construction industry. However, just like other software

applications discussed in this chapter, BIM applications also rely on the provision and maintenance of accurate information. The quality and quantity of the information required for these applications is higher than currently seems to be produced in practice. Equally Fu et al. have found that the standards for information interchange can have gaps and rather than enable information interchange they hinder it.[136] It would seem achieving the quality and quantity of information necessary for these applications requires additional time and skill during the modelling/documenting process and could consequently have an adverse effect on the efficiency and productivity of the process.

We have reviewed *must have* software applications, their consumption within construction and their effects on the processes and working practices that adopt them. The trend seems to be towards the provision of greater quality and quantity of information during the pre-construction phase, what Tweed has referred to as information's "infinite egress".[137] He attributes this trend to the relative ease with which computing devices can cope with it, rather than to any rational process of improvement. Current research has revealed some problematic aspects to this trend, where attempts to deploy such applications in a practical working context revealed the quality of the information provided was inadequate for the software application to produce accurate results. While this aspect of current research relies on increasing the quality and quantity of information, practical adoption of these applications in a working context suggests that obtaining the quantity and maintaining the quality of the necessary information may be problematic unless working practices change. We see participants working practices being marginalised at the expense of these technologies as they are brought to centre stage.

2.3.2. Proprietary devices

The computing technology that has been discussed in the previous section is not mobile, it is found on desks within the offices of design and construction organisations. In the last two decades computing has broken away from the desktop,

[136] For more on this see Changfeng Fu et al., "Ifc Model Viewer to Support Nd Model Application," *Automation in Construction* 15 (2006).

[137] Tweed, "Supporting Argumentation Practices in Urban Planning and Design," p. 357.

as computing devices become smaller, more powerful and robust. Within construction there is particular interest in mobile computing devices and the potential benefits that they might have for the process of construction. As technology continually evolves new devices—such as Apple's iPhone—are emerging all the time. Figure 2.5 is an example of an early device, a digital hardhat[138] enabled with a small camera which allows the wearer to capture, store or retrieve information while on the construction site. It is necessary for the wearer to carry a pen tablet touch computer, which limits the ability of the wearer to interact naturally with participants and the construction environment. However, more recent research and development by Petzold and Bürgy has created a computing system, which is a discreet *hands free* system[139] that replaces the pen touch tablet computer by concealing the components of the computer throughout the user's clothing. Petzold and Bürgy have also tested a software concept for a 3D user interface to help eliminate the need for the user to be tied to a traditional screen based computer interface; this system, although innovative remains conceptual and not yet robust enough to be deployed on construction sites.

Figure 2.5 Early proprietary digital hardhat

Figure 2.6 PDA currently used for monitoring

Generic technologies—such as mobile phones and digital cameras—have also found their way onto construction sites. The organisation COMIT (Construction Opportunities for Mobile Information Technology) investigates the use of

[138] "Digital Hardhat System," in *Emerging Construction Technologies*, ed. Digital Hardhat System (2004).

[139] F Petzold and C Bürgy, "Hands Free: A Wearable Surveying System for Building Surveying" (paper presented at the CAAD Futures, Vienna, 2005).

proprietary technological devices designed specifically for use on construction sites. Successful cases have utilised devices like that illustrated in Figure 2.6, which are small and robust enough to survive the construction environment. These devices are usually based on Personal Digital Assistants (PDAs), handheld computers or the aforementioned pen tablet touch computers. Stent, a large engineering organisation have a system that enables their engineers to monitor piling activity on construction sites using pen tablet touch computers. Laing Utilities use handheld computer for on site safety audits, and other construction organisations have been documented using PDAs like the one illustrated in Figure 2.6 for snagging[140] as construction projects approach completion.[141]

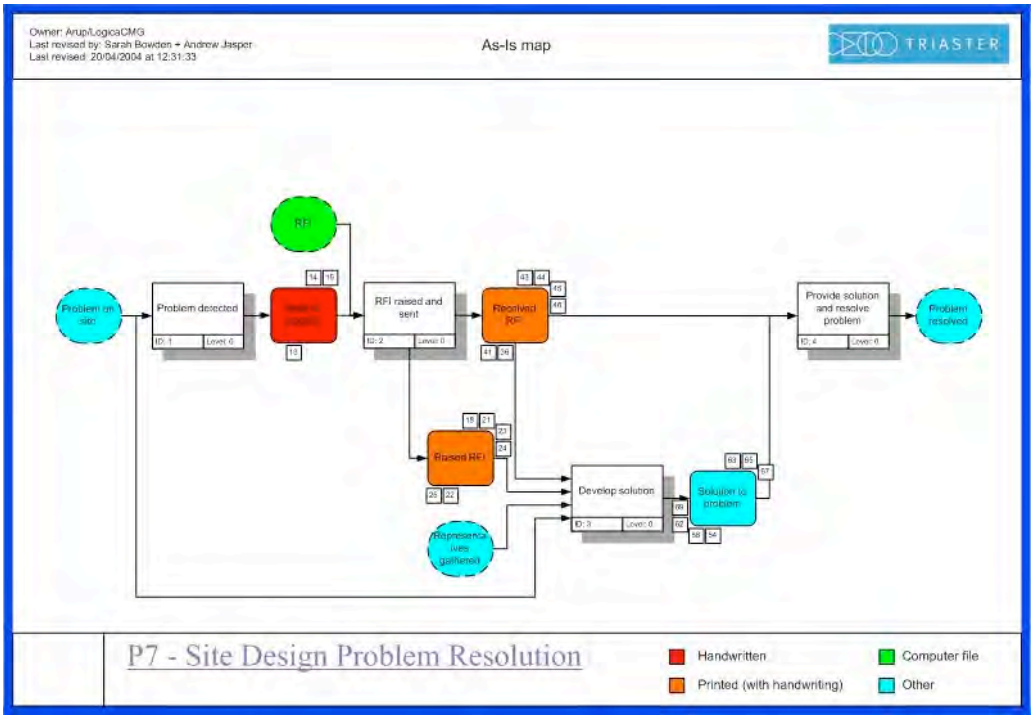

Figure 2.7 COMIT process 'as is' map (image by COMIT)

[140] *Snagging* is the construction terminology that refers to the practice of identifying minor 'snags' as a construction project nears completion. These snags must then be rectified by the contractor.

[141] For more on this see COMIT, *Lessons Learnt* (COMIT, 2005 [cited 27.04.06]); available from http://www.comitproject.org.uk/lessonsLearnt.jsp.

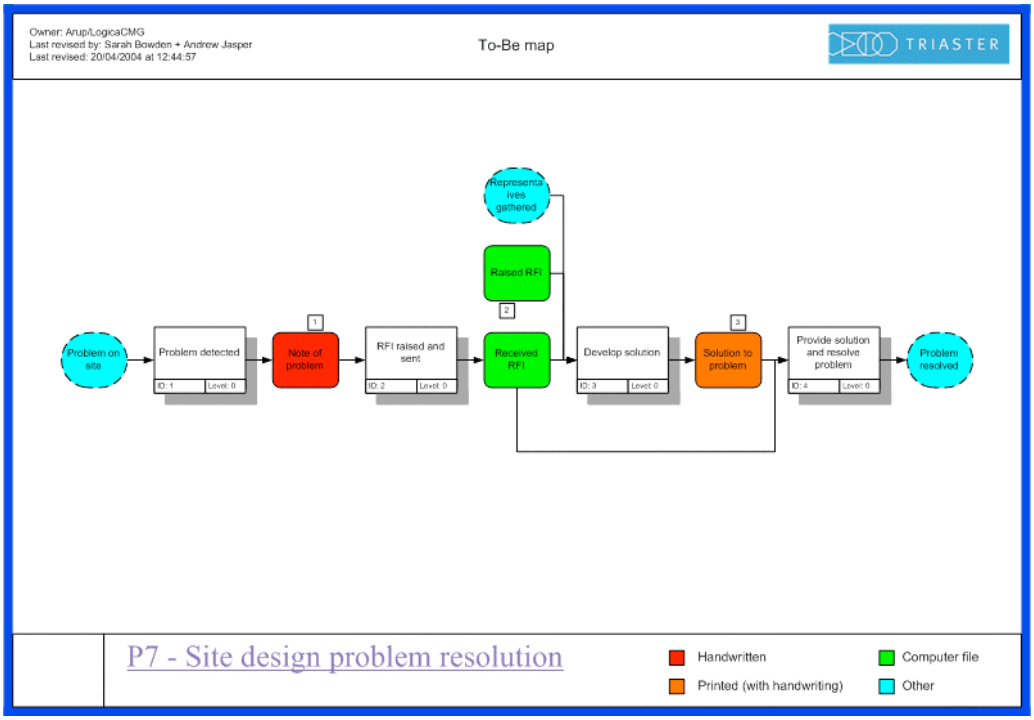

Figure 2.8 Simplified COMIT process 'to be' map (image by COMIT)

The aim of these proprietary devices is to improve a process through technological intervention. Figure 2.7 is an analysis of one such process by COMIT and Figure 2.8 is the same process now improved through utilising information technology. Diagrammatically the process now has fewer components and seems a more direct process, it is presumed that this will translate into a more direct *real* process. Stent and Laing also carried out similar studies on existing working practices within their organisations before developing proprietary devices. While these devices are not overly expensive, the cost of the research and development can be. During research to develop a PDA-based system for building recognition, Tweed has documented some of the complexities and difficulties that routinely have to be overcome to develop these systems.[142] Consequently implementation is limited to large construction organisations that have both the ability to fund this extensive

[142] The work involved in the development of a proprietary device can be considerable. Tweed has documented the development of a proprietary handheld device for use in the built environment in Wanji Mai, Gordon Dodds, and Chris Tweed, "A PDA-Based System for Recognizing Buildings from User-Supplied Images," in *Mobile and Ubiquitous Information*, ed. F. Crestani (Berlin: Springer Verlag, 2004).

research and have the volume of work to obtain a return on their investment if the technology is deployed.

What is noticeable about the propriety devices that have been discussed in this section is their highly specialised nature. The report from COMIT suggests that devices are designed for very specific activities within an organisation and they receive limited deployment on construction sites because of the specialised function and limited role for which they are designed. This is in marked contrast to mobile phones, a technology that has quite a general function and has seen widespread deployment on construction sites. Mobile phones have evolved from phones into handheld computers capable of running sophisticated software applications.[143] While proprietary devices have seen limited deployment on construction sites, modern mobile phones—which are scaled down computing platforms—are widespread. Increasingly there is the potential for these devices to be programmed with proprietary applications, rather than designing proprietary devices to run them.

2.3.3. Technological focus

What is noticeable about the technological devices we have reviewed in this chapter is they are concentrated within the management level of design and construction. With the exception of mobile phones—which have been appropriated by participants rather than implemented by management—the focus on technological intervention is absent beyond management and monitoring activities. As noted by Bowden there is little focus on the Point of Work Activity (PoWA) where sub-contractors are engaged in the actual construction work,[144] working separately Tweed has also acknowledged this lack of willingness to implement systems that are not clearly beneficial.[145] Nevertheless, some research is being undertaken to address

[143] The Blackberry and iPhone are good examples of mobile devices which are perhaps more akin to mobile computers that to our traditional notion of a phone.

[144] For more on this see Bowden et al., "Mobile ICT Support for Construction Process Improvement." Also see *A Vision for Construction IT*, which was created with almost exclusive involvement from management and organisational perspective. For more on this see Marjan Sarshar et al., "A Vision for Construction It 2005-2010: Two Case Studies," *Engineering, Construction and Architectural Management* 9, no. 2 (2002).

[145] Tweed, "Supporting Argumentation Practices in Urban Planning and Design."

the underlying causes of this.[146] If we consider the structure and evolution of construction that was reviewed in chapter one we see a threshold exists between the large construction organisations, which are engaged predominantly in the *management* activities of construction, and the smaller sub-contractors who are sub-contracted to *execute* different aspects of construction. It is beyond this management threshold that large construction organisations have much less economic investment in direct staff. The political benefits are also reduced as the execution of the building works is predominantly by autonomous sub-contractors; consequently large construction organisations have less political incentive to promote technological innovation beyond this management threshold.

Outside the construction sector Kling has explored the barriers between management and execution,[147] which can influence the success of technological implementation. Kling suggests that change is unlikely to happen in areas beyond where tangible benefits from that change can be perceived. Where substantial change is imposed to benefit the overall working process of an organisation, it is likely to be resisted by participants who identify only small or no personal benefits from it. Similar political forces would also seem to act on construction, where large construction organisations are reluctant to invest beyond the threshold of their management structure, as the other organisations are active beyond that threshold and it is perhaps perceived that they would benefit more than the large organisation.

In this section we have reviewed technological intervention in construction and illustrated that current research focuses on organisational activities. Office-based software applications are being developed to increase systemisation of pre-construction organisational activities and to increase the complexity of design descriptions at the expense of arcane social and professional activities that occur during design and construction. Mobile proprietary devices have found their way onto construction sites, however they are used exclusively by management roles.

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[146] For more on this see Martin Sexton, Peter Barrett, and Ghassan Aouad, "Motivating Small Construction Companies to Adopt New Technology," *Building Research and Information* 34, no. 1 (2006).

[147] For more on this see Kling and Iacono, "The Control of Information Systems Developments after Implementation."

Actual construction site *execution* activities have yet to be fully explored within the current research partially because of the economic and political barriers we have discussed. Where technological interventions have been found on construction sites, they were within site management or monitoring activities; PDAs and computers used to monitor, record, track and inspect work. COMIT report that benefits from mobile technological intervention are exclusively management or monitoring activities. We would suggest the discussed economic and political threshold limits the extent to which these large organisations will consider investment for technological change. Both COMIT and Peansupap[148] have identified the on-site Point of Work Activity as an area that could potentially benefit from technological intervention. Yet the threshold between the management and execution of construction continues to be a barrier that restricts potential investment and investigation into technological intervention at the Point of Work Activity.

2.4. INCREASED COLLABORATION

This section will look at current research within construction that explores collaboration through technological intervention. It will look at the theme of collaboration through three strategies, *knowledge management*, *facilitation* and *mediation.* We do not wish to distinguish between sub-contractors that undertake domestic scale construction and those that sub-contract exclusively within large construction projects; we will use the term *sub-contractors* to encompass both groups. Also within the sub-contractor group we include tradesmen in the mould of the micro-entrepreneur where they are an individual and may be operating within the cash economy.

Tweed claims the age of the “heroic” designer has passed,[149] while reflecting on the fragmentation of the design and construction process. The industry now promotes collaboration and this is usually achieved through implementing a combination of the strategies that have already been discussed in section 2.2 and 2.3.

[148] Peansupap and Walker, "Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations."

[149] Tweed, "The Social Context of Caad in Practice."

This section will draw examples from those previous sections and focus on the influence of these strategies on collaborative aspects of construction.

This facet of current research is partially driven by statistical analysis similar to that conducted by Josephson and Hammarlund, which claims the cost of defects caused by discrepancies between design and construction is in the region of 15-30% of the overall defect cost of construction.[150] This aspect of current research aims to reduce the discrepancies between design and construction by improving collaboration between the participants, thus reducing unforeseen eventualities. The continued increase in specialisation amongst sub-contracting organisations also suggests that increased collaboration will prove beneficial to the construction process. The sub-contractors—as well as carrying out work sub-contracted from large construction organisations—also undertake private domestic scale contracts. These small construction contractors make up a substantial percentage of the construction industry. Figure 2.9 illustrates that contractors who employ no more than 13 employees make up over 90% of the UK's construction industry. Large construction organisations that employ over 25 people only make up 3% of the construction industry. Small scale domestic contracting is potentially an important sphere of activity, occasionally the subject of research[151] it is often overlooked in favour of engaging with large-scale construction organisations.

[150] P.E. Josephson and Y. Hammarlund, "The Causes and Costs of Defects in Construction: A Study of Seven Building Projects," *Automation in Construction* 8, no. 6 (1999).

[151] For further reading on small scale construction see Subashini Hari, Charles Egbu, and Bimal Kumar, "A Knowledge Capture Awareness Tool: An Empiricial Study on Small and Medium Enterprises in the Construction Industry," *Engineering, Construction and Architectural Management* 12, no. 6 (2005). Also see M. Sohail and A.N. Baldwin, "Performance Indicators for 'Micro-Projects' in Developing Countries," *Construction Management and Economics* 22 (2004).

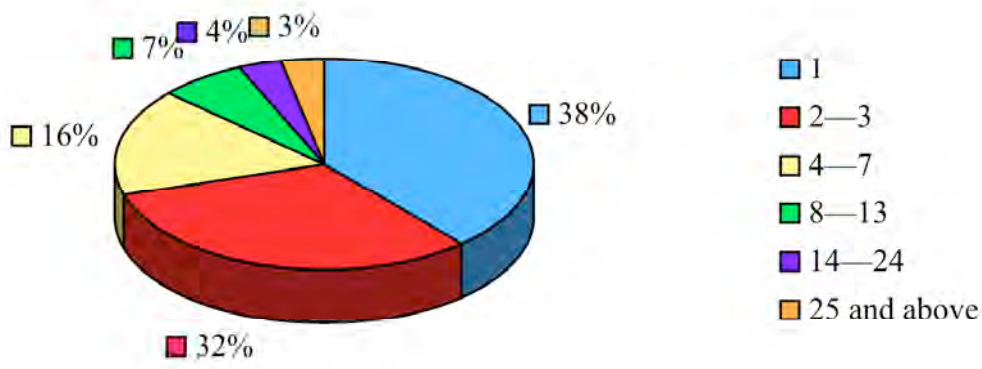

Figure 2.9 Construction Industry: Size of company by numbers employed, over 90% have less than 13 employees[152]

While the need for collaboration is greater during larger construction projects where more sub-contractors are involved, there is also a need for collaboration in the smaller domestic scale construction. However, as we discussed in the previous section the cost of research and development limits current research to large construction organisations. There are benefits to be gained from collaboration beyond the programmatic advantages that are the focus of large organisations. Brown and Duguid have advanced the association between collaboration and innovation through empirical evidence. Their case studies of Apple, Xerox and AT&T demonstrate that serendipity within these collaborations have resulted in innovation.[153] Where collaboration is promoted they demonstrate substantial benefits to problem solving and innovation, both of which can exert profound influence on programmatic aspects of design and construction.

2.4.1. Knowledge management

We have discussed a number of research projects in this chapter that address co-ordination through knowledge management within the construction industry. Path rage et al. suggests this domain is becoming increasingly important as the industry

[152] Pottier and Achur, "Construction Statistics Annual 2007."

[153] Brown and Duguid, *The Social Life of Information* p. 147-72.

continues to fragment into smaller and specialised sub-contractors.[154] Collaboration through the management of knowledge to enhance decision-making within this fragmented environment is gathering both government[155] and academic[156] support.

One strategy that we have already discussed in a previous section is encouraging more design clarification, Kagioglou[157] who subscribes to this view proposes the *Process Protocol*. This strategy has been mapped from the manufacturing industry. This process according to Kagioglou invests more in design development pre-construction and consequently has the potential to reduce design change during construction and again promotes construction as an *assembly* process. It suggests that construction knowledge can be limited to explicit assembly knowledge. Also—as discussed in more detail in section 2.2.2—Roy proposes the *Process Document* strategy,[158] which proposes more rigorous documentation and the inclusion of quality and assembly information. These two examples represent different approaches to managing knowledge. The Process Protocol seems to suggest construction can be made more efficient through more pre-construction consideration, and in doing so will reduce the amount of knowledge participants require for the construction process. The Process Document acknowledges the knowledge requirements during the construction process and attempts to represent this knowledge explicitly within documentation that could be shared by the participants.

Improving construction by encouraging the sharing of knowledge is not widely practiced within the design and construction process. The feedback stage of

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[154] Pathirage, Amaratunga, and Haigh, "Tacit Knowledge and Organisational Performance: Construction Industry Perspective."

[155] DTI, "Competitiveness White Paper: Building the Knowledge-Driven Economy.," ed. Department of Trade and Industry (Department of Trade and industry, 1998).

[156] For more on this see Mie Y. Chim, Chimay Anumba, and Patrica M. Carrillo, "Internet-Based Collaborative Decision-Making System for Construction," *Advances in Engineering Software* 35 (2004). Hari, Egbu, and Kumar, "A Knowledge Capture Awareness Tool: An Empiricial Study on Small and Medium Enterprises in the Construction Industry."

[157] Kagioglou et al., "Rethinking Construction: The Generic Design and Construction Process Protocol."

[158] Roy, Low, and Waller, "Documentation, Standardization and Improvement of Construction Process in House Building."

the RIBA Plan of Work is intended as a stage for reflecting on lessons learnt from a construction project so that *knowledge* can then be fed into the next construction project. However, the Plan of Work is vague regarding how this is to be achieved. More tacit systems for collaboration through knowledge sharing are being developed and have been discussed in section 2.2, such as the Cross-Organisational Learning Approach (COLA)[159] and the Knowledge Advantage (K-Adv) Model[160] both of which attempt to prevent knowledge loss during construction by the inclusion of additional working practices within the construction process to facilitate the sharing of knowledge. The COLA project has been deployed on a limited basis within construction and encourages workshops between the different participants of a construction project in which they share knowledge. It has received positive results, and has been implemented on several projects in the UK by the Highways Agency and the Ministry of Defence. Nevertheless, there are problematic aspects to its implementation:

> What was revealed was a broad consensus about the problematic issues of collaboration and communication within the construction domain—lack of communication, shifting requirements, negotiation of professional boundaries, limited views of responsibility, a lack of trust, resistance to change, lost and limited information, short-termism etc. [161]

As the above quote suggests, although these knowledge management strategies—according to both Roy and Cushman—have had some success in practical deployment within construction and could have a significant role to play in the future evolution of the construction process, both scholars imply that lack of trust is inhibiting the adoption of these strategies. A strand of current research is

[159] For more on this see Cushman and Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach."

[160] For more on this see Walker, Maqsood, and Finnegan, "The Culture of the Knowledge Advantage," in *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*, ed. Abduk Samad Kazi (Idea Group Publishing, 2005).

[161] Cushman and Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach," p. 69.

addressing the notion of trust in construction.[162] However, a growing body of research suggest the current competitive construction culture creates an environment that proves problematic for these strategies.[163] The research suggests that the sharing of knowledge can have positive effects on the construction process. Yet the widespread implementation of knowledge management strategies is currently hindered and will require construction culture to shift towards creating an environment that promotes common objectives and shared ownership during construction, rather than the current environment that promotes competition.

2.4.2. Technological facilitation

We have discussed previously in this chapter that occasionally there may be covert reasons for the introduction of a technology within a process. However, it is more usual that the intention of technological implementation is to enhance a process. Coyne et al. provide some examples of this where the adoption of CAD in the early 1990s influenced small architectural practices enabling them to undertake larger projects than previously possible.[164] Technology being equated with faster production has generally been an influential factor in the integration of computing technology into the design and construction process. Technological intervention can cause additional effects not limited to increasing the speed of a working process. One such effect can be illustrated in the creation of Shoal Fly By, a sculpture in Melbourne by the artists Michael Bellemo and Cat Macleod. This elegant tubular structure shown in Figure 2.10 required the close collaboration of artists, mathematicians, computer programmers, pipe benders and fabricators. Like a traditional construction process, participants in the construction of Shoal Fly By had their own specialised area of expertise and they collaborated throughout. Unlike traditional construction, in this example computing technology was not implemented

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[162] Peter McDermott, Malik Khalfan, and Will Swan, "Trust in Construction Projects," *Journal of Financial Management of Property and Construction* 10, no. 1 (2005). Also see Jones and Kaluarachchi, "Operational Factors Affecting Strategic Partnering in Uk Social Housing."

[163] Some research has revealed mistrust and scepticism hindering successful collaboration, for more on this see Andrew R.J. Dainty, Geoffrey H. Briscoe, and Sarah J. Millett, "Subcontractor Perspectives on Supply Chain Alliances," *Construction Management and Economics* 19 (2001).

[164] Coyne et al., "Computers in Practice."

to increase the speed of the process. It was implemented as a means to translate the artistic design into a description that could be comprehended by other participants such as the pipe benders and fabricators. Collaboration during Shoal Fly By was unlike construction as collaboration was not through typical abstracted construction documentation; instead the computing technology was appropriated to enhance collaboration through the translation of the design into a very specific description using language and syntactic structure unique to the pipe benders[165] and unintelligible to the other participants.

Figure 2.10 Shoal Fly By, completed using innovative collaborate working practice (image from SIAL)

Mark Burry—one of the RMIT researchers involved in Shoal Fly By—calls this Computer Sponsored Convergence,[166] which he argues enabled a trans-disciplinary approach to the design and construction of this object. This form of collaboration facilitated a closer relationship between participants, including designers and specialist sub-contractors such as mathematicians and pipe fabricators. Unlike a typical construction project, these sub-contractors were involved from a very early stage of design and construction, much earlier than would be found during

[165] In this instance the technology was used to convert the tubular strands into a series of numeric tables not unlike an excel spreadsheet. These spreadsheets had specific information regarding the lengths and curvatures of each section of each strand that the pipe benders would use to fabricate each element. For more on this see M Burry, "Digitally Sponsored Convergence of Design Education, Research and Practice" (paper presented at the CAADFutures, Vienna, 2005).

[166] Ibid.

a typical design and construction process. This close collaboration resulted in both an accurate description of the clients'/artists' vision, and a construction process in which there was little deviation from the anticipated construction program. This supports Lawson's argument that we discussed earlier in the chapter, in which he challenges the traditional RIBA Plan of Work (PoW) model for construction. The PoW model prevents designers and sub-contractors collaborating at such an early stage. In Shoal Fly By we see the sub-contractors consulted and involved in the design development process and influencing the specific design descriptions that were used for collaboration.

Turning for a moment to traditional construction, where organisations are occasionally included in the design development stage of a project under the partnering procurement method discussed in chapter one. Unlike Shoal Fly By a typical construction project will eventually resort to abstracted general graphical representations of designs. Although the partnering model claims to increase collaboration it does not encourage engagement with sub-contractors beyond obtaining pricing information,[167] it enables collaboration on management—not operational—working process.

Shoal Fly By is perhaps an elite example and unusual in the extremity of its depth of collaboration. Still, it reveals how technology can be appropriated to successfully facilitate greater communication and collaboration between the different participants. In this instance the participants were highly specialised and the technology facilitated a more detailed—rather than abstracted—description of the design. There is also the suggestion that this type of trans-disciplinary collaboration cultivates the sense of shared ownership and common objectives that have already been identified as factors necessary to assist the deployment of knowledge sharing initiatives within construction. This supports the proposition put forward by Wenger that it is communities of working practice that bring processes to life:

> Communities of practice are not intrinsically beneficial or harmful. They are not privileged in terms of positive or negative effects. Yet they are a force to

[167] Kagioglou, Cooper, and Aouad, "Performance Management in Construction: A Conceptual Framework." Egan, "Rethinking Construction: The Report of the Construction Task Force."

> be reckoned with, for better or for worse. As a locus of engagement in action, interpersonal relations, shared knowledge, and negotiation of enterprises, such communities hold the key to real transformation — the kind that has real effects on people's lives.[168]

Brown and Duguid simultaneously advance Wenger's proposition and challenge the industries dominant focus by claiming we should attend to working practice not outcomes and process:

> Organizations, then, should not attend to the process and process-related explanations only. They must also attend to practice. By practice, of course, we do not mean the sort of rote exercises people associate with phrases like *piano practice*. Rather we mean the activity involved in getting work done.[169]

There is clearly potential for technology to facilitate collaboration at many levels of construction from management through to the sub-contractors responsible for the actual on-site construction. These collaborations proved most fruitful—in a creative sense—in the case exemplified by Shoal Fly By where the designers and the sub-contractors collaborated from an early stage. The artist envisaged an elegant tubular structure and from the beginning of the design development pipe benders and fabricators were part of the collaboration. Understanding how these tradesmen would bend and fabricate the tubular structure became key in creating a description of the design and choosing the computing technology used to communicate this description to the pipe benders and fabricators. McCarthy and Wright couch this in terms of the dialogical nature of complex processes; like construction. They argue no part of such a system exists by itself, it exists—and must be understood—relationally with other parts.[170] It would be premature to suggest a general prescription for successful collaboration at this point; the following section explores examples where the adoption of technology becomes problematic for collaboration.

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[168] Etienne Wenger, *Communities of Practice: Learning, Meaning, and Identity* (Cambridge: Cambridge University Press, 1999) p. 85.

[169] Brown and Duguid, *The Social Life of Information* p. 96-97.

[170] McCarthy and Wright, *Technology as Experience* p. 72.

2.4.3. Technological mediation

In this section we explore collaboration in instances where communication is *mediated* through technology. Rather than creating a design description that enhances communication and collaboration, these examples demonstrate the adoption of technology creating design descriptions that decrease the potential for successful collaboration.

Take for example the process of drawing a wall in the ArchiCAD software, this requires the selection of the wall tool followed by one click of the mouse to begin drawing the wall and one click of the mouse to end it; as illustrated in Figure 2.11. This process is reasonably intuitive and straightforward within the ArchiCAD software. However, for ArchiCAD to create its *virtual model* a substantial amount of covert information—as illustrated in Figure 2.12—is included in this process automatically. Initially a CAD operator may not necessarily have all this information, in which case it is often included ad-hoc[171] or the software—as illustrated—includes this information as *default* setting. The covert inclusion of this information enables the CAD operator to continue working without having to alter their working practice to source and include this information. However, as the design evolves there is a risk this ad-hoc or default information will be used and cause problems during construction, or as revealed by DeVries et al. it becomes problematic if appropriated by virtual models for unanticipated purposes.[172]

[171] In the previous section we have referred to a lack of accuracy in the 3D model causing problems in other research initiatives. Those undertaking the research suggest this is one of the reasons for the lack of accuracy.

[172] In the previous section we discussed how a table was given a default concrete structure and became problematic for a 4D construction analysis algorithm. For more on this see DeVries and Harink, "Construction Analysis During the Design Process".

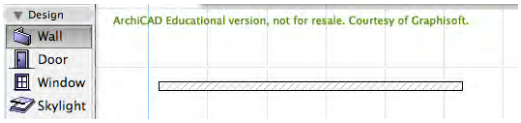

Figure 2.11 Simple ArchiCAD drawing of a wall description.

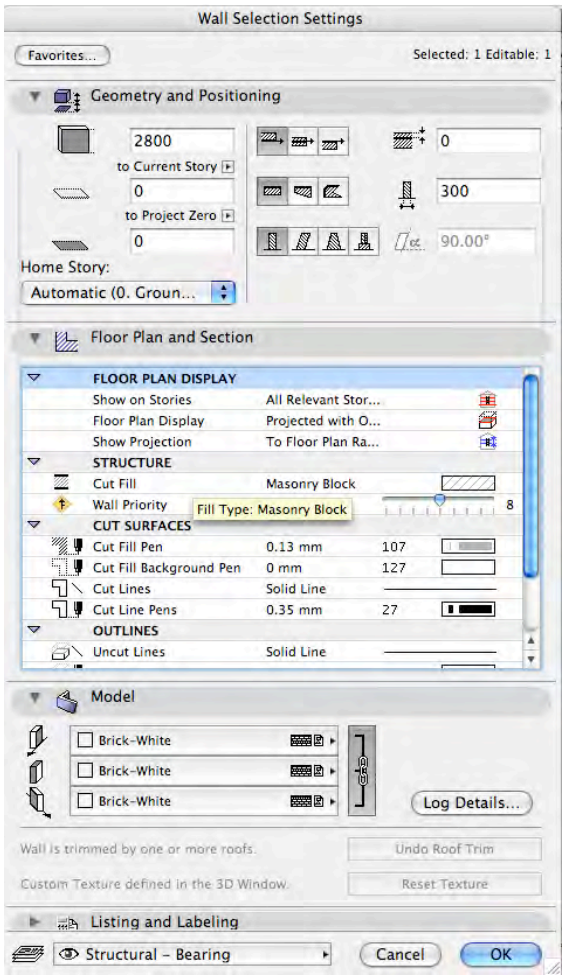

Figure 2.12 The default information ArchiCAD includes in the wall description.

As a result, increasing the detail of a design description in this manner does not seem to increase the likelihood of successful collaboration as illustrated by Shoal Fly By. Rather the provision of incorrect information will most likely hinder successful collaboration, and potentially increase discrepancies between design and construction. This does not resonate with Brown and Dugout's assertion that collaboration should have a positive effect. When collaboration is mediated in this manner through computing technology it must be described so it can be processed robustly by the hardware and software. Consequently limits may be imposed by the technology on collaboration and design descriptions. There is a concern that this might limit the creative potential of a design description, while BIM applications

have been shown to work successfully they have been criticised for imposing restrictions on design descriptions.[173] Nevertheless the construction industry perceives substantial benefits from the use of computing technology to enhance collaboration and they are understandably encouraging the use of BIMs and their continued development.

This section has reviewed current research implicated in collaboration. The findings suggest knowledge management strategies can potentially be beneficial for communication and collaboration within the design and construction process. However, they are currently limited by the competitive culture that is prevalent within construction. We have explored technology that *mediates* collaboration, such as CAD and BIM applications that produce general abstracted design descriptions, and which may include covert information into the design description. Although this software has been proven useful there are concerns that it may impose limits on the design descriptions when it is used to mediate design solutions. We have also explored collaboration as advanced by Wenger, McCarthy and Wright through the notion of technological *facilitation* assisting the translation of design descriptions within communities of practice. Facilitation through a communication technology seems to be implicated in examples where participants converged upon a creative design and construction solution.

2.5. SUMMARY

In this chapter we have reviewed current research within the design and construction process under the themes of *re-modelling, technological intervention* and *collaboration.* The aim of this chapter is to review the current body of knowledge to which this thesis will contribute, and to expose areas within the current research conducive to investigating mobile phones within design and construction, and to establish if the contemporary description of construction that emerged from chapter one influenced the direction of current research. Findings suggest that the description of construction used by the industry does exert influence on research activities.

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[173] For more on this see Yessos, "The Singularity of Design Creativity".

The current research that has been reviewed in this chapter has been predominantly focused within large construction organisations and large construction projects. The smaller domestic scale sub-contractors—which make up over 90% of the construction industry—are largely overlooked within the research. In relation to this thesis and its intention to focus on mobile phones, the domestic scale construction sector would seem conducive to research as mobile phones are widely used throughout it.

2.5.1. Re-modelling

Different approaches have been taken to re-model construction, nevertheless these approaches remain underpinned by the RIBA Plan of Work. Strategies to re-model construction and increase its efficiency through increased systemisation—as explored by Kagioglou, Roy and Cushman—are having a positive but limited effect as the underlying competitive culture of construction limits the influence of these new models. This chapter has reviewed work by Lawson that confirms there are benefits to be gained from implementing standards—such as the RIBA Plan of Work—for the communication and organisation of the construction process. However, Lawson has demonstrated that breaking away from these systems does not automatically result in catastrophic failure, in fact Lawson's research would suggest that the more innovative design and construction solutions of Irina and Scarpa are a result of breaking away from the traditional organisational structure of design and construction.

While new models and strategies for the improvement of construction do produce results, the widespread implementation of these models is impeded by the existing RIBA Plan of Work model of construction, which—according to Lawson—misrepresents itself as a design and construction process when it is in fact a documentation process. Brown and Duguid have advanced Lawson's proposition and revealed this misrepresentation will centralise certain phenomena and marginalise others. Thus, attempts to re-model the business or litigious relationships that are built upon the Plan of Work remain beholden its centralised bias towards documentation. Some strategies—such as COLA—acknowledge that there is more to construction than assembly, participants and their individual and collective knowledge are shown

to have inherent value. However, the majority of the current research would seem to subscribe to the dominant description of construction as functional assembly. Consequently it is usually technology and not participants that take centre stage within these models. Accordingly much of the research reviewed was concerned with standardising and systematising the construction process so it can be described within this technology. Only a few—such as Shoal Fly By—seemed to engage with participant and working practice within construction.

2.5.2. Opportunities in technological intervention

It was noticeable from the review of current research that technological intervention is focused on management activities within the construction process. Where technologies—such as those documented by COMIT—were being deployed on construction sites, they continued to be used in a management or monitoring capacity. This suggests there is opportunity for further research to focus on the operational on-site aspects of construction.

Research would seem to be predominantly invested in management activities for political and economic reasons, even though research by COMIT suggests the Point of Work Activity on-site would potentially benefit from attention. Mobile phones have already been appropriated at the Point of Work Activity and as proposed by McCarthy and Wright we can utilise their presence to reveal insights into operational influence of communication technologies on working practice within this context.

2.5.3. Opportunities in micro-collaboration

Within the current research working practices within on-site construction are receiving little attention as construction reorganises and evolves, yet Wenger has sensitised us to their importance within creativity and problem solving. Mobile phones are occasionally discussed in relation to health and safety legislation and whether certain practices pose a risk to participants. Research reviewed within this chapter suggests that working practices, particularly those that *facilitate* collaboration and convergence within design and construction, are implicated in innovation within construction. Where research has focused on creativity in construction—as in the case of Shoal Fly By—the centre of its attention moves away

from management activities and towards the participants engaged in the execution of construction and the nuances of their collaboration. We have reviewed research where collaboration is both enhanced and hindered by software applications. Rather than the creative potential of construction existing within a prescribed system or technology, it seems to exist within the nuances of how the technology is used within what Wenger calls ‘communities of practice,’ which facilitate these collaborations.

This chapter aimed to establish whether the dominant description of construction that emerged from chapter one influences current research, the findings within this chapter suggest it does. The functional description and predominant conception of construction as fabrication and assembly resonates within much of the current research. The aim of much of the current research is similar to the construction sector initiatives documented in chapter one - to increase the rigour of the design and construction process. Through reviewing the current research this chapter has identified several gaps in the work, which present opportunities for further research. The operational and on-site influence of communication technology within construction has yet to be widely explored, this could be a valuable contribution to the existing body of knowledge in this area. Some of the current research projects such as COLA and Shoal Fly By considered construction in terms beyond assembly, these initiatives both focused on sub-contractors, their collaboration and the sharing of knowledge. In both these examples the collaborative activities of the participants played an important role in the construction process. In the case of Shoal Fly By they seem particularly implicated in the creation of innovative solutions. This thesis aims to reflect on the creative nature of construction; as such it would seem appropriate to focus on collaborative working practices within the construction process.

To summarise, during this chapter we have identified areas that present opportunities within the current research. This thesis will focus on investigating the use of mobile phones within collaborative working practices during on-site activities within domestic scale construction. The following chapter will reflect on these areas to define a focused research question, consider the research methods at our disposal

to address this question and finally establish a method and structure to enable this thesis to attend to the research question.

3. AIM OF THE RESEARCH AND RESEARCH METHOD

> Initially the separating of designing from making had an effect not only of isolating designers but also of making them the centre of attention. Alexander (1964) himself commented perceptively on this development 'The artist's self-conscious recognition of his individuality has a deep effect on the process of form-making. Each form is now seen as the work of a single man, and its success is his achievement only.'[174]
>
> No particular set of classifying symbols can be understood in isolation, but there can be hope of making sense of them in relation to the total structure of classifications in the culture in question.[175]

The previous chapter reviewed current research that is invested in the study of communication technology and its influence on design and construction. It identified gaps within this body of knowledge that will be partially filled by the research executed within this thesis. This chapter will clarify and focus the *aim of this research* and discuss appropriate research *methodology* before selecting one that is appropriate. It will go on to outline the *three strands of the research;* discuss the *validity of the methodology* and outline the techniques that will be used to *document the working practices* during the three strands of research. Firstly, let us consider the implications on this thesis by considering *construction as a creative process*.

Lawson's opening quotation serves as a reminder that construction is not the work of a single person or group. Yet throughout chapters one and two we see organisational models such as the RIBA Plan of Work compartmentalise the construction process into either design/construction activities or management/execution activities. Consistently throughout the recent initiatives reviewed in chapter one and the current research reviewed in chapter two only one aspect of the organisational models is exposed to scrutiny. Typically it is either design or management activities that are the focus of current research. Construction and execution activities remain largely unexplored. If we are to consider construction

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[174] Lawson, *How Designers Think: The Design Process Demystified* p. 25.

[175] Mary Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo*, *Routledge Classics* (London: Routledge, 1978) p. vii.

as a creative process we must accept it as a collaborative process. Although a building may often be credited to "a single man,"[176] construction is a process that involves many people. Douglas reminds us that isolating and separating may not necessarily contribute to "making sense of total structures."[177] In chapter one the construction process has been scrutinised from the perspective of the construction industry, where it is quickly sub-divided into sequential components of design and construction. However, when Lawson scrutinised the actual construction process[178] it resisted sub-division into sequential component parts. It seems prudent within this thesis to initially resist describing construction in terms of separate design and construction processes. Within the context the terminology *construction process* will be used very broadly to describe both design and construction activities, which occur during the construction process.

3.1. CONSTRUCTION AS CREATIVE PROCESS

In this section we will consider the limitations of the dominant description of construction and discuss the merits of considering construction as a creative process. We are reminded that within chapter one there are periodic acknowledgements to the creativity of the design and construction process, from Vitruvius acknowledging the *poesies* of design and construction through to abstract constructions such as the Sydney Opera House. However, the influence of the manufacturing process is more frequent and dominant within chapter one's narrative. By the early 1900s construction seemed to have more in common with the fabrication and assembly processes of manufacturing than the creative processes of the arts. Towards the end of the 1900s the Egan and Latham Reports continued to draw on manufacturing as an industry from which construction could yet learn valuable lessons. The conclusion of chapter one established that the current construction industry describes construction in almost exclusively functional terms. Although the artistry of construction is acknowledged within the historical descriptions from as early as Vitruvius, it has

[176] Lawson, *How Designers Think: The Design Process Demystified* p. 25.

[177] Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* p. vii.

[178] This point has been discussed in some depth in chapter two.

now been over-shadowed by a functional description of design, fabrication and assembly. This description has been shown in chapter two to greatly influence—and arguably limit—the current research.

Within chapter two we reviewed the current research that focuses on the design and construction process. We found that where research was directly linked with the construction industry it also adopted the industry's functional description of construction as fabrication and assembly. A high percentage of the research reviewed was focused on the continued development of rigid systematic procedures for management or design activities. Where research was even slightly removed from the construction industry—as in the case of Shoal Fly By[179]—it did not assume this functional description of construction. This freedom provided insights into the more arcane and collaborative activities within design and construction. Within the realm of the construction industry this freedom is restricted as these activities are prescribed by the Royal Institute of British Architects (RIBA) Plan of Work (PoW).

This section has teased out some of the potential benefits that could be gained by considering construction as a creative process for studying the influence of mobile phones within it. The absence of a prescribed structure for the design and construction of Shoal Fly By and the unconventional client/artist relieved this construction process of some of the restrictions that would have been imposed by the adoption of the construction industries fixed model of construction. The absence of these restrictions will provide greater freedom for participants, affording greater insight into construction as a creative process and the influence of communication technologies upon it. We will draw on this precedent to establish an alternative description of construction as a creative process. To do this we will study a construction project that is not beholden to the restrictions prescribed by patterns of behaviour inherent within traditional construction.

[179] Shoal Fly By is a sculpture in Melbourne and it has been discussed in some depth in chapter two.

3.2. THE AIM OF THE RESEARCH

Heidegger suggests art and technology are closely related, and a critique of technology should be from the perspective of art.[180] This suggests the essence of technology *techné* is nothing technological.[181] This thesis will firstly establish an alternative description of construction as a creative—not functional—process to counter the restrictions of the contemporary description. This unconventional description will be used as a tool to analyse the influence of mobile phones within construction. An alternative perspective on construction has only been possible within the reviewed research where the construction project being critiqued was not directly linked with the construction industry and thus did not adopt its traditional patterns of behaviour. The construction of the art sculpture Shoal Fly By involved similar components and participants to any typical construction project such as sub-contractors, clients, designers etc. It did not have the traditional restrictions imposed upon construction by official organisational models or by business and litigious forces. Within the context of this thesis it is also desirable to avoid these restrictions, particularly during the creation of the alternative description of construction as a creative process.

To summarise the specific aims that have been established for this thesis, in chapter two we documented many facets of construction where communication technology is implicated within both design and construction but were restricted to a select few participants within a specific domain of activity. This thesis will focus on one communication technology; mobile phones, which are used by many participants throughout many domains of activity. Technologies are often implemented to achieve a perceived change within a particular process and Peansupap[182] suggests that in a high percentage of cases they fail to meet expectations. This thesis will not approach this research in the same manner. It will study the influence that mobile phones are exerting on the current construction environment. Domestic scale

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[180] Heidegger, *The Question Concerning Technology, and Other Essays* p. 35.

[181] Techné is craft or skill, from Parry, *Episteme and Techne* ([cited 29.07.08]).

[182] Peansupap and Walker, "Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations," p. 193.

construction, small to medium sized enterprises (SME) and individual tradesmen all who rely heavily on mobile phones are largely absent from the research. We will use an alternative description of construction as a tool to critique both the perceptions and usage of mobile phones by SMEs within the construction process. The aim of the research is to increase our understanding of construction as a creative process and the operational influence of mobile phones during collaborative on-site activities within domestic scale construction.

3.3. METHODOLOGY

It is of course necessary to label the research strategy before embarking on fieldwork and data gathering. Although we have identified a substantial gap in the existing body of knowledge and a valuable research opportunity to investigate the influence of mobile phones within construction, it is still a very broad subject. In this section we consider the domain of construction, discuss the merits of different methodologies that might be employed, decide on a methodology for approaching a broad research subject and discuss any weaknesses in the method.

3.3.1. Methodological considerations

There are two problematic aspects of construction, which may affect the choice of research methodology. Firstly, its litigious nature may restrict access to construction sites and participants.[183] Secondly, its complexity leaves many possible variables that could potentially be key factors within this research and there is no initial way of knowing where to focus the research. Mary Douglas embraces the study of complex phenomena and promotes a holistic approach to research proposing, “no particular set of classifying symbols can be understood in isolation.”[184] This suggests it may not be helpful to isolate aspects of the investigation at this early stage, as it may not enhance what Douglas refers to as our

[183] Recording and gaining access to potentially sensitive communications is a long-standing problem inherent in the design and construction process, which has been echoed by Tweed, "Supporting Argumentation Practices in Urban Planning and Design."

[184] Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* p. vii.

understanding of communication technology in "relation to the total structure"[185] of construction. As discussed in the previous chapter the contractual nature of construction is fixed in its working practice and there may be instances where access to sources of information is restricted for legal reasons. It may be necessary to approach both the subject and the participants of construction from several aspects to obtain the information required. The chosen methodology should facilitate engagement with a complex research domain and facilitate engagement with more than one data source.

The review of current research in the previous chapter revealed scientific research methods dominate this domain of research. Systems science methodology is particularly prevalent within research that focuses on the influence of technological intervention on working practices. In such studies a hypothesis is formulated and is subsequently tested by experimentation or statistical data gathering. The research documented in chapter two also revealed that manufacturing metaphors are regularly invoked as metaphorical frameworks to advance the research and test hypothesis. Simon has written extensively on systems science and quite succinctly expresses why this methodological approach can be problematic:

> The natural sciences are concerned with how things are. Ordinary systems of logic—the standard proposition and predicate calculi, say—serve these sciences well. Since the concern of standard logic is with declarative statements, it is well suited for assertions about the world and for inferences from those assertions. Design on the other hand, is concerned with how things ought to be, with devising artefacts to attain goals. We might question whether the forms of reasoning that are appropriate to natural science are suitable also for design.[186]

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[185] Ibid.

[186] Herbert A. Simon, *The Sciences of the Artificial* (Cambridge, Massachusetts: The MIT Press, 1984) p. 132-33. Simon also discusses research of complex phenomena through simplified metaphorical analogy in this book, which is also of interest within the context of this thesis. He argues that appropriating metaphorical analogy may not necessarily be helpful if the analogy does not capture relevant similarities, which is particularly difficult when the subject of research is a complex activity. For more on this see pp. 193-229.

The manufacturing metaphors that were reviewed in chapter three were also applied exclusively to management activities[187] in controlled office environments. We discussed in chapter one how methods that are successful in controlled environments are not necessarily suited to the noise and clamour of the construction site. We can conclude that the frantic and fluid nature of the on-site construction environment, which will be exposed to scrutiny during this thesis, is not particularly well suited to these scientific research methods.

Chapter one suggests the construction sector is biased by describing construction as a series of linear functional processes. Chapter two suggests when the construction sector is linked to research it too adopts a similar descriptive syntax, which promotes a scientific causal framework for construction. Within this syntax construction is conceived as a series of isolated components, which exist in a tangible and predictable causal relationship. This type of description does not reflect the nuances of interpersonal collaboration that have been discussed in the previous chapter, nor does it reflect other micro-complexities that potentially influence the construction process. Problem descriptions, such as these, have been shown to influence the generation of potential solutions. Schön describes this phenomenon as "generative metaphor."[188] Returning to construction, we suggest that it is not coincidental that the manufacturing metaphorical description adopted by the construction sector generates initiatives that are biased towards manufacturing solutions. The absence of any clearly positive results from a manufacturing metaphorical description is suggestive of what Rittel and Webber call a "wicked problem."[189] By its nature a wicked problem is described in a manner that makes it problematic if not impossible to resolve. The research that was reviewed in chapter two suggests that scientific methods can garner results when applied to management activities within a controlled office-based environment. However, it has proved

[187] M Dolenc et al., "The Inteligrid Platform for Virtual Organisations Interoperability," *ITCon* 12 (2007), Kagioglou et al., "Rethinking Construction: The Generic Design and Construction Process Protocol." In both these examples a theoretical framework is proposed but untested in actual construction.

[188] Schön, "Generative Metaphor: A Perspective on Problem-Setting in Social Policy."

[189] Rittel and Webber, "Dilemmas in a General Theory of Planning." Also see Richard Coyne, "Wicked Problems Revisited," *Design Studies* (2005).

problematic to apply this same methodological practice to on-site construction activities. The fluidity of the process and the transience of the participants have proved problematic for implementing scientific research methods. For this research we will look beyond scientific methodology towards the social sciences.

Where research has been successful in engaging with the on-site construction environment it has adopted methodologies from the qualitative tradition. Trevor Marchand has taken an anthropological approach and reported on the construction practices of builders in the Yemen,[190] more recently he has worked with and reported on woodworking in the UK.[191] Thomas Molony has investigated the effects of mobile phones on a small group of builders in Sub-Saharan Africa.[192] In both these studies the researchers have taken a qualitative approach, restricting their research to a detailed study of a select set of examples. Given the complexity of construction projects and our interest in the nuances of collaboration, it seems prudent to follow the approach of Marchand and Molony and focusing the research on a small number of in-depth studies of the working practices and nuances of communication technology within the construction process.

3.3.2. Considering methodologies

Bryman sets out the main steps of the qualitative tradition[193] of research as follows:

1. General research question.
2. Selecting relevant sites and subjects.
3. Collection of relevant data.
4. Interpretation of data.

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[190] For more on this see T Marchand, "The Lore of the Master Builder: Indigenous Knowledge & the Democratic Process in Sana'a, Yemen," *ASA 2000 Conference Proceedings* (2000). T Marchand, "Building Traditional Minarets in Sana'a, Yemen" (paper presented at the Proceedings of Symposium on Mosque Architecture, 1999).

[191] T Marchand, "Vocational Migrants and a Tradition of Longing," *TDSR* 19, no. 1 (2007).

[192] For more on this see Molony, "Food, Carvings and Shelter: The Adoption and Appropriation of Information and Communication Technologies in Tanzanian Micro and Small Enterprises".

[193] Alan Bryman, *Social Research Methods*, 2nd ed. ed. (Oxford: Oxford University Press, 2004).

5. Conceptual and theoretical framework.

5a. Tighter specification of the research question(s).

5b. Collection of further data. (return to step 4)

6. Write up findings/conclusions.

Step one suggests a qualitative approach facilitates engagement with a general research question. Step five generates a conceptual framework and facilitates further data collection and further refinement of the research specification. Both of these are desirable characteristics of the chosen methodology, as the research will begin with quite a broad engagement with construction before we tighten the specification as the research progresses.

We will now consider several qualitative methodological approaches as proposed by Gubrium and Holstein[194]; these are naturalism, ethnomethodology, emotionalism and postmodernism. Out of these methods the first two naturalism and ethnomethodology are particularly suited as they afford a natural focus on interaction, which we established in chapter two as an area suited to further research. Of these two approaches ethnomethodology is particularly suited to the aims of this thesis, as it adopts the position that communication and language is "more than a medium through which the business of social research is conducted. It becomes the focus of attention in its own right."[195] Although ethnomethodology is unusual within the construction domain several research projects discussed in the previous chapter[196] have adopted this approach. Shoal Fly By, discussed in the previous chapter demonstrates it is not exclusively functionality that technology brings to a process. The technological intervention during Shoal Fly By not only had a functional

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[194] J. F. Gubrium and J. A. Holstein, *The New Language of Qualitative Method* (New York: Oxford University Press, 1997).

[195] Bryman, *Social Research Methods* p. 364.

[196] For more on this see Peter Demian and Renate Fruchter, "An Ethnographic Study of Design Knowledge Reuse in the Architecture, Engineering, and Construction Industry," *Research in Engineering Design*, no. 16 (2006), Marchand, "The Lore of the Master Builder: Indigenous Knowledge & the Democratic Process in Sana'a, Yemen.", Molony, "Food, Carvings and Shelter: The Adoption and Appropriation of Information and Communication Technologies in Tanzanian Micro and Small Enterprises", John Rooke, David Seymour, and Richard Fellows, "Planning for Claims: An Ethnography of Industry Culture," *Construction Management and Economics* 22, no. 6 (2007).

influence but also influenced the working relationships and activities of the participants. In the words of Garfinkel an ethnomethodological approach will allow us to:

> To treat practical activities, practical circumstance, and practical sociological reasoning as topics of empirical study, and by paying attention to the most commonplace activities of daily life the attention usually accorded to extraordinary events, seek to learn about them as phenomena in their own right.[197]

By adopting an ethnomethodological approach, commonplace activities and communications within construction can brought to centre stage. We can then turn our attention to the nuances of these communications and activities and the influence of mobile phones. Bryman points out that ethnomethodology is not actually a method; it is the "study of the methods employed in everyday life."[198] While an ethnomethodological approach will facilitate a focus on the practical circumstance of construction and will help this thesis contribute to the body of knowledge, we need to consider the specific method.

We have already concluded that a methodology should be chosen that is suited to investigating complex phenomena and should facilitate engagement with more than one data source. Multi-strategy research is an approach that addresses complex research phenomena, by employing a combination of "multiple observers, theoretical perspectives, sources of data, and methodologies."[199] It has been popularised by Denzin through *Triangulation*, a term appropriated from geometry as a method of combining information from two different locations to help identify a third location.[200] It has become a term used broadly within the social sciences for a research method that approaches a research problem from multiple perspectives.

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[197] Harold Garfinkel, *Studies in Ethnomethodology* (Oxford: Polity Press, 1994) p. 1.

[198] Bryman, *Social Research Methods.*

[199] Norman K. Denzin, *The Research Act in Sociology: A Theoretical Introduction to Sociological Methods, (Methodological Perspectives.)* (London: Butterworths, 1970) p. 310.

[200] Within geometry triangulation is the practice of locating a point by referencing its location from at least two other locations and by combining the findings a reasonably accurate position can be established.

This thesis would potentially benefit from a multi-strategy approach. Any potential weakness in one data source can be offset by the data collected from another source. This would provide a mechanism within the methodology where any limitations imposed on one data source could be mitigated by accessing it from another source. Research discussed in chapter two by Kagioglou, Penasapup, Walker and Roy has favoured engaging with a homogenous construction organisation as a single source of data. However, research that engages with on-site activities and working practices remains limited. This thesis will focus on the working practices during on-site construction, the various groups of sub-contractors and the communication that occurs therein. A multi-strategy approach would benefit the research by building recognition of contingency into the process of data gathering.

3.3.3. Methodological approach: Triangulation

As we discussed in the previous section a qualitative strategy seems most fitting to this research and the influence of technological intervention on the nuances of working practices within construction. Within this tradition, following the logic of *triangulation* allows the research to have multiple sources of data that will prove beneficial for studying the different aspects of mobile phone influence on working practices within construction. Denzin categorises triangulation into different types, the one most suited to this thesis and its aims is *data triangulation*. This will facilitate the desired engagement with several sources of data, which will enable a detailed description of construction, collaborative relationships and the influence of communication technologies—specifically mobile phones—on those relationships.

As the name suggests, a triangulation methodological approach will comprise of three strands. For this thesis each strand will have a unique aim and these strands will be intertwined to contribute to the overall aim of the research. The aim of the first strand of the research will be to create an alternate description of construction. This thesis contests that construction is a more creative process and Heidegger argues that to critique technology one should approach it from an artistic—not

technological—perspective.[201] We will use this alternative description as a syntactical structure to critique communication technology. This will provide a perspective on mobile phones within construction that is not ordinarily possible with the dominant functional description favoured by the construction sector. The aim of the second strand of the research will be to document participants' perceptions of mobile phones within construction. We will analyse these perceptions through the alternative description of construction. The third strand of research aims to document the communication during the construction process and specifically how mobile phones are used within this context. We will scrutinise the usage of mobile phones through the alternative description of construction. Finally we will use the alternative description of construction created during the first strand of the research as a syntactical structure through which we can compare and contrast the perception and usage of mobile phones within construction that will be documented during the second and third strands of the research.

This is an unconventional approach to triangulation, which would traditionally focus the three strands of research on a single phenomenon. The aims of the individual strands of research are not always best served through the study of the construction site. As such, the research will focus on different phenomena to facilitate interrogation of the construction process and help support the case for construction as a creative process.

3.4. THE THREE STRANDS OF THE RESEARCH

This section will elaborate on the three strands of the research. The second and third strands of the research project will be concentrated on construction participants and the construction site will be the source of the documentation. The

[201] Although the Greek term 'techné' has strong associations with the modern word 'technology,' Heidegger sensitised us to its origin outside its scientific framework and within 'craft, craftsmanship and art.' He draws our attention to the Greek 'poiesis' which is the root of the modern word poetry but has its origins outside its modern artist framework and within 'making.' Heidegger claims that historically poiesis was also called techné, suggesting there was a historical articulation of the two modern realms of science and art. According to Heidegger this articulation lies in human engagement and rather than technology being critiqued standing-alone, it should be critiqued through its engagement in human activities. To this end, technologies should not be reflected upon in a stand-alone scientific framework. They should be reflected upon within a more artistic framework that embraces their influence on human activities.

aim of the first strand of the research to create an alternative description of construction as a creative process is not suited to being documented within the noise and furore of on site construction. In the most insightful example of construction as a creative process the project documented was not a traditional construction project. Shoal Fly By was partially removed from the traditional behavioural patterns of the construction industry and provided an alternate perspective on construction as a creative process. With this in mind the first strand of research will use a construction project that is partially removed from—and thus not restricted by—the construction sectors' traditional patterns of behaviour.

3.4.1. Strand one: An alternative description of construction

There are benefits to be gained from generating an alternative description for construction from a process that is not restricted by the traditional patterns of behaviour of construction. During research Roy et al. found that coordinating the participants within construction organisations was difficult, even when they were willing participants in the research.[202] Smaller independent sub-contractors were particularly problematic as their work is necessarily transient and Roy suggests the competitive nature of construction creates an environment of "little innovation and adversarial relationships"[203] within construction. This makes exploring technological interventions and sharing of information problematic. Collaboration, one of the aspects of construction we are particularly interested in exploring within this thesis may be restricted by the default patterns of behaviour found in construction. Shoal Fly By demonstrates that insights into construction can be gained from unconventional projects.

To create an alternative description of the construction process the design and construction of an art installation will be used as the source of the documentation for this strand. This will facilitate access to a process that is less restricted by the traditional patterns of behaviour. This design and construction project—explained in detail in Appendix A.1—was carried out by a group of Masters students as part of a

[202] Roy, Low, and Waller, "Documentation, Standardization and Improvement of Construction Process in House Building," p. 66.

[203] Ibid.

M.Sc. in Design and Digital Media within the University of Edinburgh. The participants designed and constructed an interactive art installation and the process was similar to a construction project, it will be referred to as the *proto-construction* project. A project brief was developed and refined, a construction schedule was established and specialist sub-groups were designated responsibility for addressing specialist aspects of design and construction. While there are differences between an actual construction project and this proto-construction project,[204] studying it will provide insights into the collaborative working practices and the role of the communication technology while keeping the influence of traditional patterns of behaviour to a minimum.

3.4.2. Strand two: The perception of mobile phones within construction

The aim of the second strand of the research is to document the perceptions held by participants regarding mobile phones within construction. The research reviewed during chapter two focused on either specific technologies or specific roles within construction. This thesis has identified limited research that focuses on the influence of communication technology on cross-disciplinary working practices. It seems appropriate that the focus of this strand of research should be on a communication technology that facilitates collaboration.

For this strand of the research semi-structured interviews will be used to document the nuances of the perceptions held by participants. This method of documentation will allow for more detail than anonymous questionnaires and will allow both the interviewer and interviewee to elaborate where they deem it relevant. The aim of this strand of the research is to document the perceptions of mobile

[204] While there are substantial differences, we are specifically interested in the effects of technological intervention and the effects that these interventions have on the working practices of the group. There is a problem of practicality observing and recording working practices within an actual construction project; only a limited amount can ever be obtained. The controlled environment of the proto-construction project allows for more observation and recording of the working practices as there are not the litigious and monetary underpinnings of a typical construction project which affords more experimentation with technologies in an environment which is more conducive to sharing and revealing information.

phones within construction and scrutinise these perceptions through our alternative description of construction.

3.4.3. Strand three: The usage of mobile phones in construction

The third strand of the research will document an actual construction project, paying particular attention to the influence that mobile phones exert on participants' working practices. There have been several successful examples of this type of research documented in chapter two. Separate research projects undertaken by Marchand[205] and Lawson[206] have studied working practices within the construction process through exposing themselves to building practices. Marchand worked as an apprentice to minaret builders in the Yemen, during this period he documented the dynamics of the participants and their working practices. In a more informal study Lawson observed the construction of an igloo by students and later scrutinised the nuances of their behaviour and working practices.

A practice-led approach to this strand of the research will provide considerably greater access to the nuances of the participants' working practices than passive observation. To document a construction project we will adopt this practice-led approach and the author will participate as architect on a small domestic scale construction project. This construction project will serve as the basis for the documentation of the collaborative working practices and communication technologies used by the participants. The aim of this strand of the research is to document the usage of mobile phones within construction and scrutinise this usage through the alternative description of construction.

Having documented and scrutinised these different aspects of mobile phones in construction we will use the alternative description of construction as a syntactical tool to compare perceptions and usage of mobile phones within construction. This will increase our understanding of the operational influence exerted by mobile

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[205] Adopting a practice-led approach to research Marchand worked with the builders of the Yemen to get insight into building practices, for more on this see Marchand, "The Lore of the Master Builder: Indigenous Knowledge & the Democratic Process in Sana'a, Yemen."

[206] Lawson uses the accidental construction of an igloo by students as a means to reflect on their working practice and the discussion which was stimulated within the group by that construction, for more on this see Lawson, *How Designers Think: The Design Process Demystified* p. 18..

phones on the construction process. We will also use this alternative description of construction to scrutinise the construction process and in doing so increase our understanding of construction as a creative collaborative process.

3.5. VALIDITY OF THE METHOD

Having already discussed the benefits in adopting a qualitative approach to this research, in this section we will discuss the reliability of the method. We will also discuss inherent weakness in the method and the steps taken to minimise these weakness within the context of this thesis.

Results obtained through a qualitative research strategy are not easily generalised, unlike results obtained through a quantitative research strategy. In the construction domain the main benefits obtained from generalised results are standardised models distilled from these results, which can be widely deployed within the construction sector. In a qualitative research strategy much of the validity is—in the words of Smith and Heshusius—invested in "interpretation or description"[207] rather than through statistical proof. The *certitude* that is afforded by the large data source of a quantitative research strategy is not applicable when adopting a qualitative approach to research. Instead Brewer and Bryman[208] suggest emphasis should be placed on the rigour with which qualitative research is executed to provide *trustworthiness* in qualitative research.

3.5.1. Reliability of the method

Bryman highlights the importance of *trustworthiness* in qualitative research and outlines four criteria necessary to facilitate it: *credibility; transferability; dependability and confirmability*. We will turn our attention to each of these criteria and outline how they will be addressed.

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[207] Clive Seale, ed., *Social Research Methods: A Reader* (London: Routledge, 2004) p. 501.

[208] Brewer sets out six criteria to be followed when undertaking ethnographic research, for more on this see Ibid. p. 406. Bryman also sets out criteria to evaluate qualitative research, for more on this see Bryman, *Social Research Methods* p. 272.

According to Denzin a lack of credibility to qualitative research has the potential to leave the findings being nothing more than fiction.[209] Bryman suggests the credibility of qualitative research relies on ensuring that the research is carried out according to the cannons of good practice, and ensuring that the researcher has grasped a proper understanding of the social reality that is being studied. Triangulation is cited by Bryman as a method that addresses the latter by approaching the research from several perspectives. This creates a more complete picture of the complexity of a particular social reality. To ensure the research within this thesis is credible and carried out according to the cannons of good practice it is recommended that each strand of research be carried out individually. Each strand will have an individual focused research aim and method, which is suited to that individual strand.[210]

The second criterion for trustworthiness is *transferability* of the findings. As was indicated at the beginning of section 3.5 this is not a typical feature of qualitative research, however Bryman suggests that as far as is possible:

> Qualitative researchers are encouraged to produce what Geertz (1973a) calls thick descriptions—that is rich accounts of the details of a culture… …making judgements about the possible transferability of findings to other milieux.[211]

To this end each strand of the research will be documented as extensively as possible within the practical restrictions of a PhD thesis. This will facilitate independent judgments on the transferability of the findings.

The third and fourth criteria are *dependability*, which entails ensuring complete records are kept throughout the research and *confirmability*, which is intended to show that the researcher has not been influenced by personal values. Both of these—it is suggested—should be delegated to an auditor, which as yet is not widely practiced within a PhD thesis. However, we will endeavour to uphold—as far as possible—the spirit of these requirements by maintaining thorough

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[209] Seale, ed., *Social Research Methods: A Reader* p. 497.

[210] In the spirit of ethnomethodology rather than making reference to the more scientifically influenced 'sources of data' we will adopt the phrase 'documentation of working practices.'

[211] Bryman, *Social Research Methods* p. 275.

documentation, transcribing interviews quickly and with the assistance of a Doctorial Supervisor will remain as self-critical and impartial of the data as possible.

3.5.2. Weakness in the method

There are two main weaknesses in qualitative research, which will now be considered. Firstly, the interpretive nature of the qualitative research strategy means the credibility of the documentation rests on the rigour with which it is recorded. To address this, as we have discussed, each of the three strands of documentation will be individually and rigorously executed, although this is likely to result in substantial time being devoted to the rigour of the recording of documentation.

The second weakness is insufficient consideration being given to the quality of the documentation. To minimise the risk associated with this weakness we will consider each strand of the research individually, establishing clear aims and methods for each strand.

3.6. DOCUMENTING OF WORKING PRACTICES

In this section we will discuss the strengths and weaknesses of the different methods that will be employed to document the findings during the three strands of research. The methods of documentation will vary depending on the aim of each strand of the research and the context of the documentation. Where the context is a controlled environment—as in the first strand—much of the discourse will be recorded through online message-boards and e-mail. Focus groups will also be used to discuss observations and elicit further insight from the participants. During the second and third strands of research the context of the documentation will be the construction site and its participants. Current research suggests focus groups may be problematic, as co-ordination of participants may not be practical and disclosure of information may be sensitive. In this instance semi-structured interviews will be arranged with individuals and information will be disclosed on a one to one basis.[212]

[212] The author was engaged in other ethnographic studies during the course of this thesis. As an interview subject on the *Inflecting Space* AHRC research project the use of semi-structured interviews proved very useful to obtain insights from the interview subjects. These experiences also informed the author's choice of documentation. For more on this research project see Richard Coyne, *Inflecting*

Where we wish to document the actual working practices during on-site construction the author will participate in a construction project and maintain a case study throughout the execution of the project.

3.6.1. Focus group

The first strand of the research will be conducted within a controlled university environment. It is a similar size to a typical construction project (30 participants) and lasted for a similar duration (11 weeks). The participants are reasonably knowledgeable and are in close proximity to the author and to each other. As discussed by Wilkinson and Bryman[213] focus groups are suited to investigating social phenomena. The focus group participants will all have participated in the proto-construction project. The focus for the discussion will be the communication during the project and how technological tools operated within the communication and collaboration. An audio recording will be made of the focus group and transcribed immediately afterwards. This will be used in conjunction with the digital transcript of online message-boards and other digital communication utilised throughout the project. The benefits of a focus group in this instance are:

- The proto-construction project is a group project and insights can be gained from participants reflecting on their role.
- Most of the participants have expertise and a vested interest in digital media and could provide insight into the use of digital communication technologies.
- It will facilitate the study of participants' individual roles in a group event and the influence of communication technologies on their roles and on group dynamics within the proto-construction project.

For some of the participants English was a second language, for this reason it was decided it would be beneficial to keep the focus groups small. 3-5 participants would keep the focus group within suggested limits and prevent an imbalance in

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Space: Correlating the Attributes of Voice with the Character of Urban Spaces (2005 [cited 15.08.08]); available from http://ace.caad.ed.ac.uk/InflectingSpace/.

[213] Bryman, *Social Research Methods* p. 248, S Wilkinson, "Focus Groups in Feminist Research: Power, Interaction, and the Co-Production of Meaning," *Women's Studies International Forum* 21 (1998).

relation to the English/non-English speakers. When the project was complete the participants' quickly dispersed and only one viable focus group was secured before this happened, which according to Bryman[214] is not optimal.

3.6.2. Semi-structured interview

The aim of the second strand of research is to document a participant's perceptions and for this, semi-structured interviews will be employed. As suggested by Beardsworth and Keil[215] semi-structured interviews would allow for lateral movement by both the interviewer and the interviewee during the interview. As suggested by Bryman a list of questions will be prepared[216] and used by the interviewer as the basis for the interviews. The interviewee will be encouraged to elaborate if the interviewer deems it appropriate and within the scope of the research. These interviews will be transcribed to a digital medium as quickly as possible after the interview.

In addition, during this strand of research opportunist interviews with individuals were grasped wherever possible and recorded on whatever medium was at hand. As they were impromptu the questioning was not as structured or thorough as the semi-structured interviews. However, they were transcribed into a digital medium as quickly as possible.

3.6.3. Case study

The case study is what Bryman describes as an *exemplifying* case, not strange or unusual but an ordinary instance of a domestic construction project. Taking a practice-led approach to this strand of the research, the author participated and documented the project as an active participant. For the case study a log was maintained in which developments were recorded on a weekly basis. Letters and correspondence from the authorities were also recorded along with mobile phone

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[214] Bryman, *Social Research Methods* p. 350.

[215] A Beardsworth and T Keil, "The Vegetarian Option: Varieties, Conversations, Motives and Careers," *Sociological Review*, no. 40 (1992).

[216] Bryman, *Social Research Methods* p. 321.

SMS messages. This along with the drawn information comprises the documentation for the case study.

3.6.4. Integrity of the documentation

The accuracy and integrity of the documentation takes on particular importance within the qualitative tradition of research. It is assured as far as possible with audio recording, where allowed and note taking during interviews with immediate transcription when possible. During the case study the log will be maintained throughout the duration of the project, thus recording actual events and personal thoughts. This is combined with relevant official documentation that will be exchanged throughout the project as well as mobile phone records and records of other unofficial correspondence that has been recorded.

This constitutes the end of the first section of the thesis; the next chapter will be the beginning of the second section of the thesis. In the following chapter we begin the first strand of the research, it will discuss in more detail the aim of the first strand and how it will be executed.

4. STRAND ONE: AN ALTERNATIVE DESCRIPTION OF CONSTRUCTION AS A CREATIVE PROCESS

> The frenzied-ness of technology may entrench itself everywhere to such an extent that someday, throughout everything technological, the essence of technology may come to presence in the coming-to-pass of truth. Because the essence of technology is nothing technological, essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it. Such a realm is art. But certainly only if reflection on art, for its part, does not shut its eyes to the constellation of truth after which we are questioning.[217]

> Arguably, the overemphasis on technological solutions for managing knowledge within large organisations has contributed to the relatively high failure rate of knowledge management (KM) within many industries and organisations.[218]

In the previous chapter we established the aim of this thesis, which is to increase our understanding of construction as a creative process and the operational influence of mobile phones during collaborative on-site activities within domestic scale construction. We also chose a suitable methodology and outlined a structure of three strands of research to achieve the aim; this chapter will begin with the first of the three strands. The aim of this strand of the research is to document a construction project and through our observations generate an alternative description of construction as a creative process. We will begin this chapter by discussing the choice of construction project to be documented and then discuss the method of documentation of this specific strand for this research before summarising the findings and exposing them to scrutiny.

4.1. CONSTRUCTION AS A CREATIVE PROCESS

McCarthy and Wright inform the mode of enquiry for this chapter, they suggest more consideration is placed upon working practice and resist placing

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[217] Heidegger, *The Question Concerning Technology, and Other Essays* p. 35.

[218] Andrew R.J. Dainty, "Hrm Strategies for Promoting Knowledge Sharing within Construction Project Organisations: A Case Study," in *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*, ed. Abduk Samad Kazi (Idea Group Publishing, 2005), p. 19.

technology centre stage.[219] Heidegger's also adopts this position and in the opening quotation suggests we should reflection upon technology through an artistic lens. This thesis is focused on investigating technology that is specifically implicated within the communications during construction. It then seems appropriate to approach construction from the perspective of an art or craft so that in our study of technology we resist placing it at centre stage. This approach is intended to address the problem posed by Dainty in the opening provocation, which suggests emphasis on a technological solution may be inappropriate. He implies the relatively high 70% failure rate might be directly related to overemphasis on technological solutions.

Let us consider Shoal Fly By, the sculpture that has been described in chapter two, as an example where construction is depicted as a process involving more than the functional facets of fabrication and assembly. It would be presumptive to suggest that this project was particularly invested in studying construction as a creative process. However, it provided a broader description of construction and within that description we see communication technologies and the collaborations afforded by those technologies positively influencing the translation of the designed object into a constructed object. The creative solution was not embodied within the standard off-the-shelf technology utilised during the project, but it was influenced by the nuances of collaborations and communication that came into being because of them. Shoal Fly By is an exemplar of a richer description of construction, which has revealed the creative potential inherent within the construction process through embracing not only functional aspects of the construction process but also collaborative and communicative facets that are facilitated by technology.

There are potential benefits to be gained by using an art-based project as a basis for the documentation of this strand of the research. Consequently this strand of research will study an art-based *proto-construction* project. The documentation will focus on communication technology and its role within collaboration during the design and construction process. Sections 4.5 to 4.9 will then reflect on the findings

[219] McCarthy and Wright, *Technology as Experience* p. 191-92.

and expand upon emergent themes that will constitute our broader alternative description of construction.

4.2. QUESTIONS CONCERNING TECHNOLOGY

In this section we consider some of the relevant issues when studying technological intervention within a process. We begin by drawing from Donald Norman, who argues technology can promote certain types of behaviour by a user,[220] the often-cited illustration of this argument being door handles. When a handle clearly affords holding it is often ambiguous as to whether pulling or pushing is required to open the door, hence the necessity for *push* or *pull* labels. However, a stainless steel or plastic plate fixed to a door only affords the behaviour of pushing, and thus a sign for the user becomes unnecessary, so a push-plate in place of a handle affords a certain type of behaviour. Robert Evans has written extensively regarding the evolution of documentation and communication between design and construction. He argues that new devices and tools are likely to change the complex constellation of practices that make up a process.[221] Brown and Duguid also attest to technology's propensity to "unsettle equilibria whenever they are found."[222] Even though phones have been part of our communication toolbox for quite some time, the seemingly benign evolution of this device into the *mobile* phone would seem to influence constellations of practices and unsettle equilibria in the design and construction process. According to these scholars technology has the potential to influence both behaviour and working practice.

Molony has exposed this proposition to further scrutiny, specifically in relation to mobile phones and their effects on the working practices of small businesses—including construction—in sub-Saharan Africa.[223] In his research, mobile phones have been shown to affect the dynamics of communication and the

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[220] Norman, *The Psychology of Everyday Things.*

[221] For more on this see Robin Evans, *Translations from Drawing to Building and Other Essays, AA Documents; 2* (London: Architectural Association, 1997).

[222] Brown and Duguid, *The Social Life of Information* p. 75.

[223] Molony, "Food, Carvings and Shelter: The Adoption and Appropriation of Information and Communication Technologies in Tanzanian Micro and Small Enterprises".

relationships between clients, suppliers and sub-contractors. Investigating change caused by mobile devices within construction in the UK are organisations like COMIT (Construction Opportunities for Mobile Information Technology)[224] who explore the influence of new modes of documentation and communication such as mobile phones, personal digital assistants (PDA) and digital cameras. Specifically COMIT are invested in ensuring that appropriated technologies positively influence the flow of information and working practices during design and construction. COMIT place emphasis on finding a technological solution, perhaps more than Dainty and Heidegger—in their opening statements—would approve of.

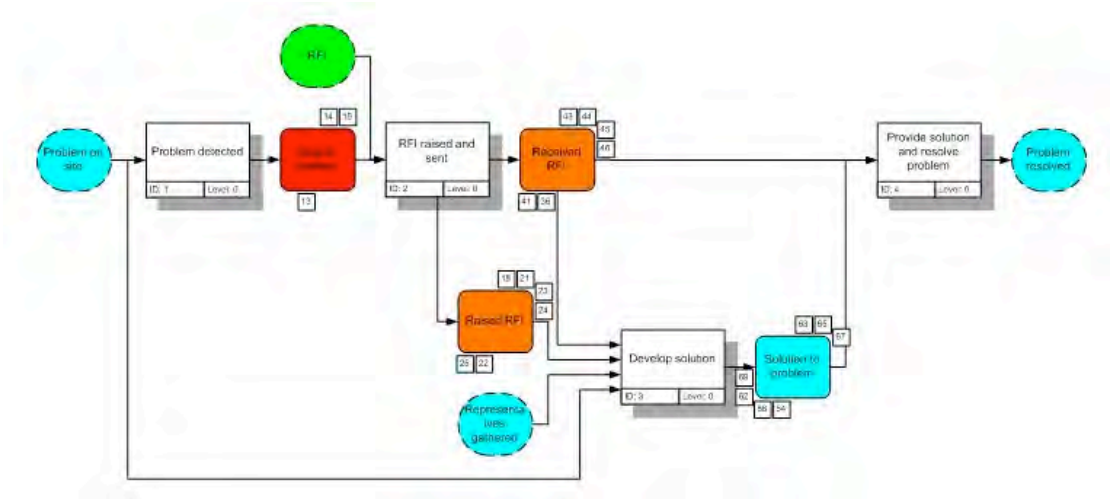

Figure 4.1 Diagrammatic COMIT problem resolution 'as is' map to be improved (diagram by COMIT)

COMIT isolate particular elements of construction practice, such as the problem resolution ‘as is’ process during construction as illustrated in Figure 4.1. This process is exhaustively analysed to produce a more refined process as illustrated in Figure 4.2 The improved/simplified COMIT problem resolution 'to be' map. However, Evans, Brown and Duguid draw attention to the problematic of the impulse to re-engineer and argue it may cause unexpected effects. By studying a construction project and taking the culture of construction practice into account, this

[224] For more on this see COMIT, *Current Status of Mobile It* ([cited 27.04.05]).

research aims to facilitate a broader description of communication technology and its influence within communication and collaboration.

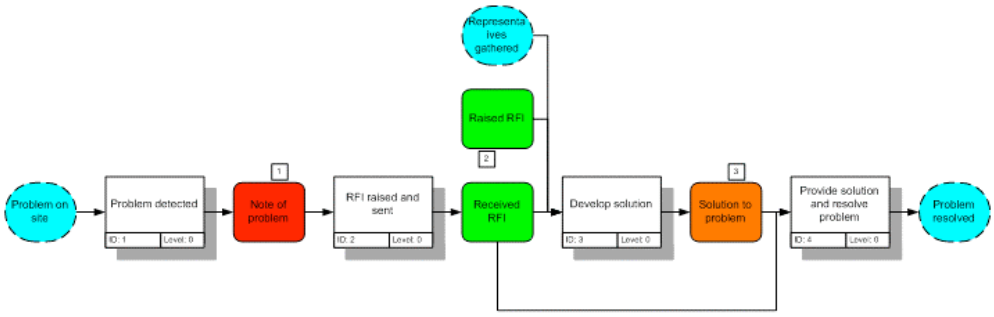

Figure 4.2 The improved/simplified COMIT problem resolution 'to be' map (diagram by COMIT)

Heidegger sensitises us to the origins of technology in the Latin *techné,* which signifies not only the activities and skills of the craftsman, but also—according to Heidegger—the arts of the mind and the fine arts. This contests the notion that technology is neutral; it exerts influence on both the people and the process in which it is implicated. Heidegger's argument has currency within the context of this thesis in which the contemporary functional description of construction dominates the discourse. This description focuses the critique of the construction process on functional and technological aspects whereas Heidegger suggests the focus should be from the perspective of art and attending to the interaction of participant, activity and technology. This strand of the research will not limit the documentation to purely functional and technological aspects of the construction process; it will embrace broader facets to assist in the production of an alternative description of construction as a creative process.

4.3. A PROTO-CONSTRUCTION STUDY

In the previous chapter we observed the use of an art based construction project to provide insight into a broader perspective on the construction process. Adopting an art-based project as the source for the documentation for this strand of

the research will potentially benefit our alternative description of construction and should afford insight into naturalistic communicative processes, which would not be possible through the documentation of a traditional construction project.

4.3.1. An Art-Based Study

In chapter two a number of projects—including Shoal Fly By—drew attention to the communication between the participants within the construction process. It revealed how the appropriation of communication technology can have both positive and negative effects on communication; within this strand of the research we will be paying particular attention to the communication and collaboration between the participants during the proto-construction project. The alternative description of construction will potentially benefit from documenting an art-based project. Within such a project, participants will not automatically resort to traditional behaviour or responses inherent in the construction environment, consequently there will be fewer limits on communication. In the absence of these restrictions and a reduced influence of the "adversarial relationships"[225] they potentially cause, a more conducive environment should exist for open discussions with participants on the design and construction process. Research by Cushman[226] that was reviewed in chapter two suggests that these group discussion sessions proved to be an insightful research tool. After completion of the proto-construction project we will take advantage of this improved environment and organise focus groups to discuss the project.

4.3.2. The Proto-Construction Project

The proto-construction project comprises the design and construction of an art installation. It is an end of year project and involves an entire class of students enrolled on an MSc in Design and Digital Media within the Architecture Department of the University of Edinburgh. The course on which the participants are enrolled is also implicated in the use of technology within a creative context; the MSc course

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[225] Roy, Low, and Waller, "Documentation, Standardization and Improvement of Construction Process in House Building," p. 66.

[226] For more on this see Cushman and Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach."

encourages discussion and reflection on the appropriation technology for design and construction activities. The design and construction of the art installation is outlined in detail in Appendix A.1. It has many programmatic similarities to a typical construction project:

- It has a fixed design and construction period of six weeks.
- The group has to schedule the design and construction programme as illustrated in Figure 4.7, which included intermediate deadlines and critical junctures within the design and construction process that were necessary for co-ordination and collaboration to maintain the anticipated schedule.
- The participants have a fixed final deadline directly related to the end of the semester when the project would be opened to the public.

Similar to a typical construction project the participants are a multi-disciplinary group that includes highly skilled designers, technical specialists[227] and lesser skilled individuals who take on general roles—not unlike general labourers—within the project. The participants will be divided into sub-groups, resembling sub-contractors and specific trades that participate within a typical construction project. Only in the case of the proto-construction project they will not be electricians, builders etc, they will be the *on-line log* team and *interactive* team etc. The participants will have to interact and negotiate the design and changes to the design, as the project evolves throughout the design and construction of the proto-construction project. Images from the design and execution of the proto-construction project are found in Figure 4.4 to Figure 4.6.

[227] This including specialists in programming, 3D modelling, video production and motion tracking, programming etc., skills that participants had developed within other aspects of the MSc. Design and Digital Media course.

Figure 4.3 Setup of Art Installation

Figure 4.4 Testing of Equipment in Art Installation

Figure 4.5 Guests visiting the Art Installation

Figure 4.6 Participants have a well deserved tea break

Mobile phones do not feature as heavily within the proto-construction project environment as in a typical construction project environment. However, the participants have also developed the skills—in other aspects of the course—to design and deploy additional communication technologies. The documentation of this strand of the research will not be restricted to mobile phones; it will cover as much communication as possible in whatever medium the participants choose to use.

Figure 4.7 Art installation programme schedule

4.4. THE DOCUMENTATION OF THE PROJECT

The focus of the documentation of the proto-construction project has been informed by collaboration observed during Shoal Fly By. There will be a focus on the teamwork between the participants during the project and how communication technology is used operationally during construction within these alliances.

4.4.1. The Aim of the Documentation

The aim of this strand of research is to document an alternative description of construction. This description intends to include not only the functional facet to construction that dominates the discourse reviewed in chapter two, but to also include broader facets of construction such as collaborative activities and the role of communication technology within those collaborations. This alternative description has been influenced by research from Marchand, Molony and Burry[228] where additional facets—beyond functionality—of communication and the influence of technology were implicated within the construction process. Although these

[228] For more on this see Burry, "Digitally Sponsored Convergence of Design Education, Research and Practice"., Molony, "Food, Carvings and Shelter: The Adoption and Appropriation of Information and Communication Technologies in Tanzanian Micro and Small Enterprises". Also Marchand, "The Lore of the Master Builder: Indigenous Knowledge & the Democratic Process in Sana'a, Yemen."

additional facets are perhaps esoteric and nuanced, they would seem to be implicated in construction as a creative process.

4.4.2. Method of Documentation

The participants within the project were enrolled on an MSc course in Design and Digital Media and naturally gravitated towards using digital tools as a means of communication. During the very early stages of the project, meetings were held to discuss ideas; initially much of the project discourse was carried out by *e-mail* and on a simple sequential on-line *message board* that was being used for general course related discussion. As part of the project one of the sub-groups—the on-line log team—developed and deployed an elaborate compartmentalised *forum* in which each sub-group was allocated a space for discussions and file upload. The digital records of the message board and the forum have been documented in Appendix A.1.

The proto-construction project ran its course and afterwards the message board and forum records were downloaded and used to analyse the design and construction process and also the communication and collaboration that took place. Having analysed the digital records of the communication during the project, we elicited further insights from organised focus groups where the project and the communication practices were discussed in more detail with the participants. The transcripts of the focus group have also been documented in Appendix A.1.

4.5. ANALYSIS OF CONSTRUCTION AS A CREATIVE PROCESS

This section will analyse the documentation from the proto-construction project, reflect on the different communication technologies that were employed during the project and how the participants used them during the construction process. We will discuss these under the emergent themes of function, tension and negotiation.

The general idea of *weather/threshold* was presented to the group at the beginning of the project and during weeks one and two the participants held occasional meetings to discuss the specifics of the weather/threshold idea and how they might interpret that idea. As individual themes started to emerge from this idea the communication moved to the informal on-line *message board* as illustrated in

Figure 4.8. The last message posted on the message board appeared at the bottom of the course website, which was set as the default homepage on all computer Internet browsers provided for this course. Being set as the default homepage on the course computers had the effect of making the message board highly visible to the project participants. A complete message list could be viewed easily as no security measures were in place,[229] anyone visiting the website could contribute to this message board.

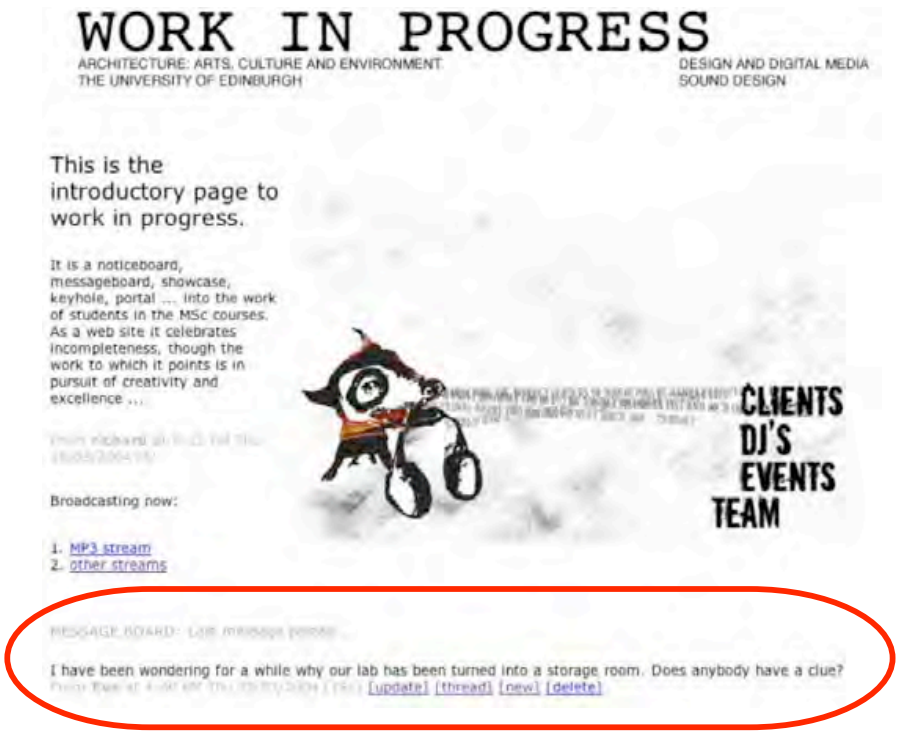

Figure 4.8 Course homepage with the message board located and circled at the bottom

Construction of the art installation commenced during week four of the project, when the participants secured a venue and began ordering materials. Up until this juncture the project participants had been appropriating the informal message board, at this point one of the sub-groups—the *online log team*—felt the need to formalise the project discourse and created a more structured digital *forum*, as illustrated in Figure 4.9. This forum provided individual compartments for specific sub-groups and an organisational structure for communication and digital resources.

[229] More recently a security code must be typed in when posting a message, this became necessary to avoid 'spamming.' However during this project no such measures were necessary. It is also worth noting that in 2004, when this was active, this type of open message board was not common and pre-dates the common acceptance of user-generated content, which has become widely known as web 2.0.

The other sub-groups used the forum extensively, particularly for detailed and lengthy discourse on a specific subject.

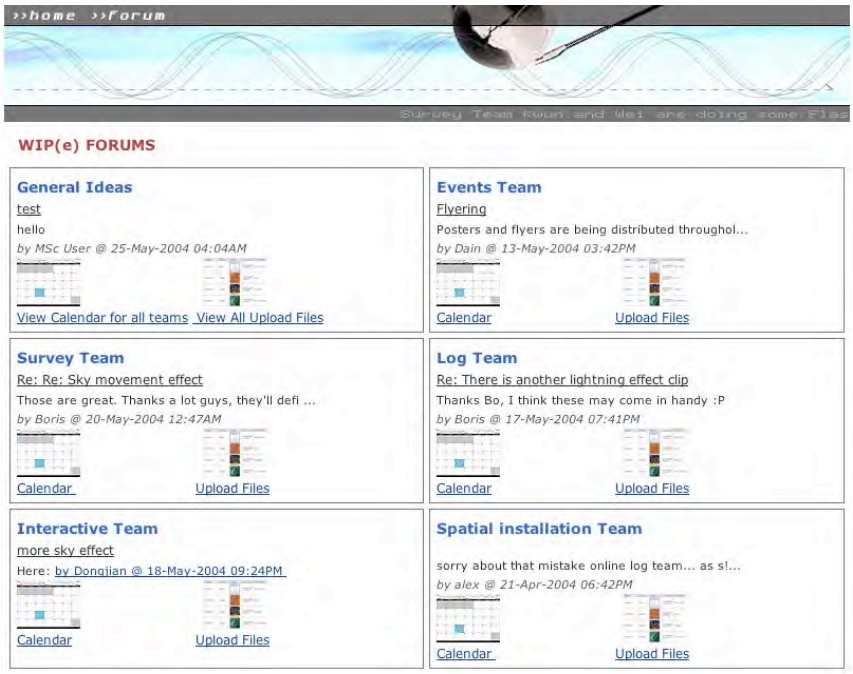

Figure 4.9 Proprietary course forum designed to contain the project discourse

As well as the functional facet to construction, which dominates the contemporary description we analysed in chapter one, we could identify additional facets that also influenced the construction process. There was also a *tensional* facet to the process that proved influential where some participants exerted political pressures on others. Leading on from McCarthy and Wrights assertion that tension and innovation are related,[230] Bakhtin has written extensively on Carnival and suggests tension is necessary in maintaining Carnival as a creative process. Bakhtin illustrates a problematic aspect to these tensional forces:

> The "authoritarian word" does not allow any other type of speech to approach and interfere with it. Devoid of any zones of cooperation with other types of words, the "authoritarian word" thus excludes dialogue. Similarly, any

[230] McCarthy and Wright, *Technology as Experience* p. 155-59.

> official culture that considers itself the only respectable model dismisses all other cultural strata as invalid or harmful.[231]

When something, such as the forum, is established in an *authoritative* or *official* role, as it was during the proto-construction project it can create an environment devoid of Bakhtin's zones of cooperation, it "dismisses all other cultural strata as invalid or harmful," as indeed the forum did, thus creating tension between the official and anything that might be deemed unofficial.[232] We will draw on Bakhtin periodically throughout this section to interrogate the tensional politics of the official/unofficial and the opportunities that Bakhtin argues can arise because of its presence.

As well as the functional and tensional facets we also identified a facet that we will for now describe as *negotiation*. This is where participants who had particular communicative needs negotiated communication between two or more technologies to meet that need. In the proto-construction project this was typically the message board and the forum. However, Shannon and Weaver suggest greater freedom of choice does not equates to innovation and creativity, but rather to greater uncertainty:

> The greater this freedom of choice, and hence the greater the information, the greater is the uncertainty that the message actually selected is some particular one. Thus greater freedom of choice, greater uncertainty, and greater information go hand in hand.[233]

This is considered a negative effect with Shannon and Weaver's scientific framework as it increases the *uncertainty*. Equating greater choice with greater

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[231] Mikhail Bakhtin, *Rabelais and His World*, trans. Hélène Iswolsky (Bloomington, IN: Indiana University Press, 1984) p. x.

[232] For more elaborate discussion on official/unofficial communication see Appendix A-6 for: Dermott McMeel, Richard Coyne, and John Lee, "Talking Dirty: Formal and Informal Communication in Construction Projects" (paper presented at the CAADFutures: Learning from the Past, Vienna, 2005). The author in collaboration with others has developed these themes while this thesis was evolving. For a more elaborate discussion on these themes specifically in relation to authority, see Appendix A-6 for: Dermott McMeel and Richard Coyne, "Dirty Work" (paper presented at the 18th British HCI Group Annual Conference: Designer, User, Meaning Maker: Rethinking Relationships for a more Creative HCI, Leeds Metropolitan University, 2004).

[233] Claude Elwood Shannon and Warren Weaver, *The Mathematical Theory of Communication*, [A reissue.], The Mathematical Theory of Communication. ed., *[Illini Books. No. 1b-13.]* (Urbana: The University of Illinois Press, 1963) p. 18-19.

uncertainty would seem to resonate with the contemporary description of construction that emerged from chapters one and two, where certain knowledge management initiatives[234] attempt to reduce choice on construction sites by prescribing the design, specification and method of construction precisely. Later in this chapter we will draw on other sources that challenge this position and argue that uncertainty is implicit in creative and design activity.

We will begin our analysis of these facets by discussing the functional facet of the proto-construction process before turning our attention to the facets of tension and negotiation.

4.6. FUNCTIONAL FACET OF COMMUNICATION TECHNOLOGY

In the early stages of the project the message board was heavily used, it had been introduced to the participants the previous semester and was the only public communication medium available. The participants throughout the project used the message board and their familiarity with it was undoubtedly a factor in its continued use, as suggested by the focus group:

> I think the first week it [the forum] was up people were still posting messages to the message board because they were familiar with it.[235]

Lack of familiarity caused similar behaviour with the message board, when it was in its infancy the following message was posted a few days after it was deployed:

> Why does nobody use this? Richard 11:24 AM Thu 15/01/2004.[236]

Although the participants' increased familiarity with the message board may have contributed to its appropriation in the early stages of the proto-construction project, insights gained from the focus group revealed that the use of the message board during these early stages also proved beneficial for brainstorming ideas. As

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[234] For more on this see Roy, Low, and Waller, "Documentation, Standardization and Improvement of Construction Process in House Building." Also see Kagioglou et al., "Rethinking Construction: The Generic Design and Construction Process Protocol."

[235] See Appendix A.1, section 13.4, [11:40].

[236] See Appendix A.1, section 13.2, message [56].

illustrated in Figure 4.10 and 4.11 an idea born in the middle of the night that might otherwise have been forgotten became a central icon to the project due to its appearance and subsequent reappearance on the message board:

> Brainwave: We lend every visitor an umbrella, but we don't tell them what it's for. They then wander around the installation thinking about weather and stuff holding an umbrella. And they will wonder why. Personally I think that is genius. Who's with me? Henrik 1:42 AM Tue 27/04/2004.
>
> Henrik! Yeah, that's genius. I'm with you, all the way, we just have to buy lots of umbrellas. This idea is a great transition between the "transitions" and "weather" themes. Good. In/out. Luke 1:46 AM Tue 27/04/2004.
>
> We are also with you Henrik :-) Eve 12:14 PM Tue 27/04/2004.[237]

Figure 4.10 Proto-construction project umbrella icon

[237] See Appendix A.1, section 13.2, message [289] [290] [291].

Figure 4.11 People using umbrellas in the art installation

The reappearance of the umbrella idea was not in itself enough to cement it as the central icon. However, it did bolster the confidence of the creator to commit to the idea:

> I'm going ahead with the umbrella idea by the way. Henrik 11:28 PM Tue 27/04/2004.[238]

The message board facilitated the process of brainstorming; its location and ease of access enabled a wide spectrum of participants to access it. This is unlike other brainstorming tools such as the KJ Method[239] as it did not seem to assist with decision-making, which was still in the hands of the projects participants, nor did it focus the attention of the participants on central ideas. [240] The message board enabled

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[238] See Appendix A.1, section 13.2, message [295].

[239] For more on this see Jared M Spool, *The Kj-Technique: A Group Process for Establishing Priorities* (User Interface Engineering, 2004 [cited 01.05.04]); available from http://www.uie.com/articles/kj_technique/.

[240] To further explore the phenomenon of on-line discussion, rumour and demise, accretions and deletions, spread and consolidation, as observed in the installation project, we also designed a follow-up, very limited, messaging device, which was deployed later during general studio work. The messaging device was radically stripped down, devoid of threads and compartmentalisation. It

a fringe idea to be drawn into the discourse and eventually become central to the project.

When the forum was deployed it provided a structure for compartmentalising conversations or *threads*. The focus group revealed the participants considered this very useful; one of the micro-teams—the survey team—used it to post a series of videos and generate user comments on them. The comments included some praise and some suggestions for improvements:

> You can have several 4-second clips with different amounts of liquid. The flash rain with the sound is very effective. Very close shots could be quite useful. Nice job so far.[241]

Technical issues were also raised here, perhaps not of interest to a wider audience, but important to the authors of the video clips:

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included a class list (for each contributor to tick) and a single text field containing an editable instance of the current text. Additions were incorporated into the existing text at the discretion of the user. Initially the procedure was anonymous, and after a few days, a thread was revealed which would show different instances of the text to the user as it evolved. We seeded the messaging device with an initial proposition (about Bakhtin's theme of embodiment), prompting the users to elaborate on a theme with which they were becoming increasingly familiar. The messaging device was world readable and the students were encouraged, over the course of one week, to contribute.

Following a focus group with the students to discuss the results, we decided to seed the messaging device for a second time, with a paragraph of text that would promote refinement, rather than elaboration, of a topic. This involved a slight modification of the device to limit the amount of text it would hold. Otherwise the device remained the same. This time (based on the focus-group discussion) the device was seeded with the intention to create a succinct description of the city of Edinburgh. Although we have not included these explorations of on-line message boards within the body of this Thesis they brought the themes of *elaboration* and *refinement* to centre stage regarding on-line discussion. These themes have made their way into this thesis although the terminology *expansive* and *intensive* discourse has been used.

Rumour machine seeded for elaboration

Rumour machine seeded for refinement

For more on this see Appendix A-6 for McMeel, Coyne, and Lee, "Talking Dirty: Formal and Informal Communication in Construction Projects".

[241] See Appendix A.1, section 13.3.5.

> I think we not only have to know the features of the videos you need, but also what those features would be used for so that we can optimize them. Would you need those videos in solid background for extraction? Do we need to think of the camera angles that may be suit for the situations you are going to composite with? You mentioned close-up. But why all close-up? I think we have to know about this before filming or making the simulations.[242]

The discourse benefited from being privatised within one compartment of the forum rather than spread out between other messages, which would have been the case if the message board had been used for this particular discussion. The participants could mine a subject matter to greater depths with this type of medium than with the message board. However, this *privatisation* did prove problematic if the need arose to contact many of the participants involved in the proto-construction project. In these instances the message board would be re-appropriated for communication. The focus group revealed the general course dialogue being carried out on the message board was now seen as an interruption of the project discourse:

> Because there were topics [in the forum] you could check back, the other message board was just sequential, people get interrupted.[243]

Nevertheless after the forum was deployed the message board continued to be periodically re-appropriated throughout the project for communicative discourse that required trans-disciplinary involvement from several sub-groups. The following message was posted in week six of the project by one of the sub-groups to test the viability of a new idea:

> Henrik and I have been discussing the possibility of using live weather data from a site Kevin has found to modulate some sonic aspect of the installation (weather-based soundscapes being created by Pete). Kevin, have you made a script to extract the data? I'm working on a way to communicate this to Max/MSP (via Open Sound Control) and so need to know what the nature of the data will be. Could you let me know which parameters (pressure, temperature etc.) you will be sending and how often? If it updates every 30 minutes we could have a 30-minute delay and ramp slowly between values so that they are constantly changing which might be interesting. Henrik said

[242] See Appendix A.1, section 13.3.5.

[243] See Appendix A.1, section 13.4 [20:10].

> Aragon also might be able to help with this? Thanks, Bob 10:34 AM Sun 12/05/2004.[244]
>
> Or to broadcast a general message:
>
> Hi everyone! Is there any version of the poster (prepared by the Publicity Team) available online? Also, is there any website for the installation, if so, what is the URL? Hope everyone's ok. Thanx :-) George 6:51 PM Thu 13/05/2004.
>
> George, there is no version of the poster online but if you really want it I could send it to you. Also, the site is www.chang-ed.co.uk Miro http://www.chang-ed.co.uk 12:4 PM Fri 14/05/2004.[245]

The findings from the documentation of this proto-construction project challenge some common suppositions found during the literature review in chapter two. Firstly there is little evidence to suggest the communication technology used within the proto-construction project can or should be linked with particular stages of the design and construction process. Secondly there is also little or no evidence to suggest that certain communication technologies could be associated with particular sub-groups or roles within the construction process. The only exception to this was the online log team who—because of political motivations—engaged in coercion to promote forum usage; this will be discussed in more depth later in this chapter.

There is evidence to suggest that we can associate the forum and message-board communication technologies to particular types of working practice. Both technologies were used for what we will term trans-disciplinary communication. A participant usually appropriated the message board when they wished to communicate very broadly with many of the participating project disciplines. The early brainstorming stages of the project benefited from this communicative affordance, and later the project benefited as the message board was appropriated to broadcast and test the viability of new ideas. This suggests the message board was appropriated when—what we will call—*expansive discourse* with other participants was considered most effective.

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[244] See Appendix A.1, section 13.2 message [339].

[245] See Appendix A.1, section 13.2 message [341] [342].

The forum seemed to be appropriated by participants when a more narrow trans-disciplinary discourse or focused discussion was intended; as the video clip instance that we discussed previously illustrates. In this case the participants discussed detailed requirements for video clip lengths, angles and compression, these details would have been fragmented on the message board. However, within the forum they remained privatised in a specific compartment, which the participants could return to if necessary. This suggests the forum was appropriated when—what we will call—*intensive discourse* with other participants was considered most effective.

4.6.1. Message Board and Expansive Discourse

During the early stages of the project the message board was appropriated to post ideas and initially disseminate those ideas to participants who were geographically dispersed. It assisted in overcoming gaps between the participants, both physical gaps as some of the participants chose to participate from outside the immediate project environment and temporal gaps as participants worked at different times, some during the daytime and some at night. The message board was a highly visible medium located on the course homepage and was used for general course dialogue. Popular ideas would rise above the general dialogue and repeatedly reappear on the top of the linear stream of messages on the course homepage. This high level of visibility undoubtedly bolstered the role of the message board within the expansive trans-disciplinary process of brainstorming.

The designers of the forum had provided a *general* category that was intended to replace the message board:

> We should start posting on WIP(e) from now on for general comments and also to observe how other teams are progressing.[246]

The general compartment within the forum never completely gave way to the message board, which suggests that the functional traits of the message board were never completely embodied by the general compartment of the forum. In fact the

[246] See Appendix A.1, section 13.2 message [263].

general compartment was more elaborate and provided more functionality,[247] but was not as obviously visible as the message board. For the duration of the project the forum was located at www.radiowipe.co.uk and the participants had to actively go to the forum (1 mouse click), select the general compartment (1 mouse click) and then select the specific message that they wished to see (1 mouse click). There was more effort required to use and see the general compartment within the forum than to use the message board.[248]

Late in the project we observed the message board being used when design changes were being considered. As discussed in the previous section one of the sub-groups wanted to use live weather data in their particular aspect of the project, they posted their proposed change on the message board asking for information to quickly assess if the change was feasible. This suggests that the high level of visibility and the communication that it afforded is implicated in the creative potential of these collaborations. Throughout the proto-construction project we see trans-disciplinarity implicated in the creation of creative opportunity, perhaps more so within the message board that affords much more fluid and expansive communication and thus more potential for unexpected collaborations.

> Could you let me know which parameters (pressure, temperature etc.) you will be sending and how often? If it updates every 30 minutes we could have a 30-minute delay and ramp slowly between values so that they are constantly changing which might be interesting. Henrik said Aragon also might be able to help with this.[249]

The participants combined the functionality of these communication technologies, for example, prior to the above posting on the message board, the survey team were conducting intensive discourse within a compartment of the forum

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[247] The message board was simply a sequential series of messages; each message could include an Internet 'link' to another Internet location. The forum allowed for the compartmentalisation of subjects, which meant a response to a specific message could be contained with that original message. As well as the 'link' functionality of the message board, the general category also had the ability to upload files.

[248] As it was located on the course homepage when anyone logged into the course computers or opened any of the Internet web browsers they were automatically taken to the course homepage with the last message board posting on it, and a full archive of the message board was only 1 mouse click away.

[249] Appendix A.1, section 13.2, message [339].

to work out some technical details of their proposition[250] before they posted the above request on the message board to involve other disciplines.[251] Brown and Duguid add support to our claim that the cross-collaboration of the message board has value. They describe organisational processes like the forum as 'longitudinal.' They argue and bring evidence to bear on 'lateral' ties—as provided by the message board—being key to improvisation and creativity.[252] They have identified in case studies no precise piece of explicit knowledge within collaborations that leads to the solution. By involving the artistic metaphor of watercolour, they make a case that the product of cross-collaboration is greater than the sum of its parts:

> Neither had a decisive "piece" of knowledge. Nor was the final solution the property of either one. It was a collective process that created an indivisible product. Thus we tend to think of knowledge less like an assembly of discrete parts and more like a watercolour painting.[253]

Beyond these trans-disciplinary functional benefits of the message board, there were also passive benefits to the appropriation of the message board for communication. Any potential changes within the proto-construction project may affect other sub-groups; by posting changes (or anticipated changes) to the message board other sub-groups would be passively informed through its high level of visibility. There were many eclectic specialist skills involved in the proto-construction project[254] it is conceivable that effects of a design change may be felt in unexpected locations far from the sub-group that instigated it.[255] Any individual team cannot always be fully aware of the implication of a change on every aspect of the project and its participants. Appropriation of the message board for these expansive communications is more likely to passively inform participants that have not been

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[250] In Appendix A.1, section 13.3.6 to section 13.3.8 the Survey team discuss the advantages and disadvantages of the different website sources of the weather data, and how they can 'grab' the data from these websites.

[251] See Appendix A.1, section 13.2, message [339] for the request.

[252] Brown and Duguid, *The Social Life of Information* p. 111-13.

[253] Ibid. p. 106.

[254] Some of the skills necessary were publicity, 3D modelling and programming.

[255] We have drawn upon Evan to discuss this phenomenon in section 4.2 Questions Concerning Technology. Also see Evans, *Translations from Drawing to Building and Other Essays.*

directly informed. The unrestricted nature of virtually all the discourse within the forum and the message board was beneficial as it allowed participants to orientate themselves and their efforts in light of the overall project. Anyone could browse the discourse of different groups or specific topics:

> Yeah, it's good to see what is going on and what's being posted even if it's not directed at me. You could go to the different groups and get an overall idea of what is going on.[256]

Returning to the message board, arguably its function within the project did not change as the project moved from design into construction. The functional traits of the message board were constant throughout, and it was consistently appropriated by the participants when they felt expansive trans-disciplinary communication would be most effective. The visibility of the message board and the high level of user traffic proved important to its usage throughout the proto-construction project. As well as expansive communication the message board also facilitated passive surveillance of the changing project and thus it is implicated in the participants' successful handling of the fluidity of the constantly evolving design and construction process.

4.6.2. Forum and Intensive Discourse

Now we turn our attention to the function of the forum. As the project evolved and the design stage of the project started to give way to the construction stage, the participants were in agreement with the proposition advanced by Brown and Duguid that deployment of an organisational structure such as the forum was beneficial to the project.[257] Participants could create specific channels that facilitated more intensive communication. These channels could remain intact, uninterrupted, and could be revisited, as in the case of the survey and documentary teams who negotiated and experimented with various formats of file exchange for the online video.[258]

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[256] Appendix A.1, section 13.4 message [20:55].

[257] Brown and Duguid, *The Social Life of Information* p. 109-11.

[258] Some of these are quite extensive but can be found in Appendix A.1, section 13.3.2, 13.3.3 and 13.3.4.

In this instance the forum facilitated communication that was also asynchronous. The participants revealed during the focus group that certain collaborating sub-groups hardly had any direct contact with each other:

> We were doing the big screen stuff and there was another team that was doing the videos but we didn't even meet them once. We could ask them to do it in this format or compress it like that and they would do it and upload it.[259]

This was in part due to the different working cultures involved in each sub-group and the different working hours each team chose to work. Some sub-groups preferred to work during the day when they had access to certain facilities and others during the night when there was less distraction in the work environment. Through the lens of phenomenology Tweed has conducted a more detailed interrogation of cultural difference within design process and he argues it is an important factor in our understanding of design descriptions and selection of working practices.[260] The forum was also being used for discourse that required more intensive interrogation of specific project details. It allowed more active orientation activity as expressed during the focus group. With unrestricted public access to the communications, individuals often checked what other sub-groups were doing:

> [The forum] was much nicer, because you could talk to specific groups of people within your group. You could upload things. Checkout what other teams were working on. So groups were carrying out their discussion in public so to speak.[261]

The privitised compartmentalisation of the forum enabled the participants to structure the project discourse. In the previously quoted example where sub-groups were discussing weather data we also see the forum being used for internal communication. The sub-group in question carried out intensive internal discussion within the forum. On the other hand we find the message board being used in parallel for fluid collaborations, generally exploring if ideas or components could fit together. Once ideas had been agreed participants wishing to collaborate more

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[259] Appendix A.1, section 13.4 message [16:50].

[260] Tweed, "The Social Context of Caad in Practice."

[261] Appendix A.1, section 13.4 message [11:20].

intensively on the specific details and logistics of these ideas were appropriating the forum.

4.6.3. Expansive and Intensive Discourse

As discussed previously the forum did not always enhance the communications within the project. The *privatisation* of the forum was identified as problematic when the intention was to communicate with all the project participants. Its designers—with the intention of replacing the message board—had provided the general compartment within the forum, although it had more functionality it lacked the visibility and user traffic that the message board benefited from:

> [20:30] Aragon: There was a bit of a problem with the privatisation within the groups. It was difficult to post something that everyone could see, if for example Luke was in my group and I wanted to post something for him, it would be extra effort for me to then post it to everyone. [262]

The additional functionality and compartmentalisation made the forum effective for intensive discourse but its poor visibility adversely affected its suitability for expansive discourse. While this may have been a shortcoming of the forum this weakness was ameliorated by the continued appropriation of the message board. Although the two modes of communication seem to compliment each other in terms of functionality, we observed their continued usage causing tension. Which is our second facet of communication and will now be exposed to scrutiny.

4.7. TENSIONAL FACET OF COMMUNICATION TECHNOLOGY

The rational behind choosing the proto-construction project was partially because it was not burdened with traditional tensions caused by the politics of litigation, contractual and monetary pressures. However, it became apparent from the documentation of the project that a tensional facet existed.

The first suggestion of emergent tension seemed to arise when the designers of the forum—the online log team—recognised that the project discourse had not completely migrated to the forum, the message board was continuing to be used by the project participants. Members of the team attempted to encourage the project

[262] Appendix A.1, section 13.4.

participants to migrate all communication to the forum, firstly by reasoning with the participants through posting messages on the message board:

> The online log team have been working very hard for the last week to get this site up and running, so please please use it. It's got a great calendar/forum section for each team and then a general forum and general calendar. We'll soon have an upload section on the site. We have lots of plans for the site with streaming and other things to come. Luke, Dexter, Jeffery, Yin,Joan. http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/index.cfm 6:58 PM Tue 20/04/2004.[263]

When this proved unsuccessful the online log team began posting messages within the forum and posting something on the message board such as "Hi, I have posted a message here"[264] followed by a link that would direct a viewer to the message within the forum. When this also failed to garner the desired result of migrating all discourse to the forum a much stronger tone was take by the forum designers, as they tried to motivate the projects participants to use the forum:

> OK, I don't want to force the issue, but let's use the forum set up, there are sections for each team and general section for everyone to use and it's taken a lot of time to get it together. I have posted some important information on the general post in regards to our team that all teams should read. Please follow the link. Don't forget www.radiowipe.co.uk is where it's at. Dexter http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/messages.cfm?id=101&Category=7#101 12:23 PM Fri 30/04/2004.[265]

The documentation of the proto-construction project revealed tension between the two communication technologies (the forum and message board) continued as the project progressed, but not because one was adversely affecting the project. As we discussed in the previous section the forum made a valuable contribution to the communication within the project, the underlying motivation behind the creation of the forum was not solely for the benefit of the project and its participants:

> We built the Radio WIP(e) website to collect and keep record of the working progress of the installation, the website includes a news section, online forums, calendars, and upload pages for each team and the whole project.

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[263] Appendix A.1, section 13.2, message [254].

[264] Appendix A.1, section 13.2, message [285].

[265] Appendix A.1, section 13.2, message [306].

> Online Log Team (Luke, Dexter, Yin, Jeffery, Joan) 12:55 PM Tue 18/05/2004.[266]

This suggests that the forum designers felt it should *collect and keep record of the working progress of the installation.* Their intention was to provide a communication forum for the project discourse but also to render the message board obsolete. Subsequent messages posted on the message board illustrate that others agree the message board should be dispensed with completely and the forum used exclusively for the proto-construction project:

> Let's use the forum set up, there are sections for each team and general section for everyone to use.
>
> We should start posting on WIP(e) from now on for general comments and to also observe how other teams are progressing.[267]

In previous chapters we have referred to Kling, who suggests that motivations behind systemisation and modernisation are not always purely functional. He has found political motivations can have considerable influence in organisations where opportunities for promotion[268] rest on increasing efficiency, often through the introduction of a computer system. During the proto-construction project the online log team deployed the forum to benefit the project, but also their skills would be measured and their contribution marked by its performance. This created the political motivation for the forum designer to encourage use of the forum, the extracts from the message board that have been quoted in this section illustrate how that motivation led to progressive coercion by one particular sub-group. However, the participants refused to give up the message board and its subversive appropriation continued to positively contribute to the project discourse.

The tension could be couched in terms of the management of content and how participants use that content within their working practices. Veen[269] has been

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[266] Appendix A.1, section 13.2, message [350].

[267] Appendix A.1, section 13.2, message [306] [263]. Message [263] was not posted by the forum designers but by one of the other participants.

[268] For more on this see Kling, *Computerisation and Controversy: Value Conflicts and Social Choices.*

[269] Veen, *Why Content Management Fails* ([cited).

involved in assessing and redesigning large content management systems such as Blogger and Flickr and has explored this tension. He suggests it is avoidable by careful consideration of the processes that rely on that content. We could suggest that within the proto-construction project no such careful consideration was given to the processes and working practices, consequently some aspects of the discourse continued to be more effective when communicated through the message board.

The previous section has established the message board facilitated expansive trans-disciplinary discourse, which can be associated with fluidity and as such implicated in creative and design aspects of the project. The forum on the other hand facilitates more intensive communication on specific details in a more structured discourse, which we established could be associated with the construction or assembly aspects of the project. However, if both modes of communication were used for the duration of the construction of the project we must then acknowledge that design or creative processes must have continued during construction activities. This challenges the trajectory of current work that aims to reduce design during construction, making it a more rigid and less fluid process.

In the next section we will take a closer look at some of the discourse on the forum and the message board, and look closer at the politics of the official and unofficial that caused the tension during the project.

4.7.1. The Politics of 'Official' Communication

The participants were never prompted to structure or organise the project discourse, the forum was an initiative of the *online log team* one of the sub-groups within the proto-construction project. The functionality of the forum should have been reasonably familiar to the participants as it was functionally similar to many online forums. We have previously invoked Kling to reveal the importance of the political motivations behind the forum deployment, and upon review of the documentation it would seem that these motivations were influential in the emergence of the tension between the usages of the two communication technologies.

The forum was extremely well considered and executed, it quickly became adopted by the project's participants as the *official* means for communicating within

the project, and other participants not directly affiliated with the online log team also felt the forum should be the only means of communication:

> We should start posting on WIP (e) from now on for general comments and to also observe how other teams are progressing. Aragon 3:10 PM Wed 21/04/2004.[270]

However, the participant quoted above who voiced this agreement is also the participant who later—during the focus group—identifies the privatisation problem of the forum. Clearly the political pressure was influential yet the continued use of the message board demonstrates that in this instance the functional benefits were more powerful as participant continued to use the message board.

Additional factors may have contributed to the forum becoming the official model of communication for the proto-construction project. The online log team who created the forum were known to have expertise in this area, and the forum looked more professional and *official* than the message board as Figure 4.8 and Figure 4.9 attests. Beyond its convincing design and appearance it also surpassed the message board in functionality with a comprehensive list of features, including a live calendar that was linked into all the sub-groups and an upload and download facility for file exchange. As Table 4.1 illustrates the forum was far superior in terms of functionality.

[270] Appendix A.1, section 13.2 message [263].

	Message Board	Forum
Message Posting	Yes	Yes
Threaded Messaging	No	Yes
File Upload	No	Yes
Attach WWW Link	Yes	Yes
Calendar	No	Yes

Table 4.1 Message board/forum functionality table

The forum has its etymological origins as a "place of assembly…a marketplace,"[271] a forum in this sense should provide a place for official and unofficial discourse. However, the forum of the proto-construction project was not used for the informal discourse and did not facilitate it as well as the message board. It is also worth noting that the participants did not initially embrace the message board either and the high volume of users of the message board that was commonplace at the being of the proto-construction project took time to grow. A critical mass of users has been identified as key within the context of web 2.0, where users will typically gravitate towards areas that others inhabit and use irrespective of the merits of functionality.[272]

4.7.2. The Politics of 'Unofficial' Communication

As the proto-construction project gathered momentum, it was assumed the use of the message board for project related discourse would cease upon the deployment of the official forum. The message board would return to being used for course discourse and the forum would be the dedicated means of digital

[271] From the Online Etymology Dictionary.

[272] For more on the benefits of quantity over quality in online user generated content, see Simon Polovina, David Bird, and Tim French, "Can Transactions and Organisational Semiotics Help Chronic, Wicked Problems through Interaction Design" (paper presented at the 18th British HCI Group Annual Conference: Designer, User, Meaning Maker: Rethinking Relationships for a more Creative HCI, Leeds Metropolitan University, 2004).

communication for the project. This did not prove to be the case and the continued use of the message board was initially considered unacceptable by the online log team who created it. As discussed previously steps were taken by the online log team to redress this continued use of the 'unofficial' message board.

The unofficial is defined by what is not included in the official. The functional benefits of the message board could partially be attributed to it being unofficial, meaning there was no hierarchy, organisation or privatisation within it. This made it much more effective for expansive discourse and as a locus of creative potential, as there was more opportunity for unexpected possibilities through the absence of such structures. Jacques Monod the biologist claims this is key to the science of genetic mutation and evolution. Monod asserts that for newness to advance complex biological systems it is reliant on chance.[273] Framed in these terms the design of the official forum was not conducive to the promotion of newness, and thus not favourable to creativity.

However, the online log team did not reconsider the function or design of the forum, but rather they coerced the participants into using it. This supports Bakhtin's opening assertion that "the authoritarian word does not allow any other type of speech to approach or interfere with it."[274] Thus the unofficial message board and the official forum existed not in a state of harmony but in tension. Mary Douglas can also add weight to this proposition and suggests that ordering and formalising an environment is a natural human instinct, part of the process of ordering is to exclude, de-clutter and remove dirt. Having exerted time and effort in doing so we attach meaning and purpose to the environment, be that a dwelling or a digital online forum:

> In papering, decorating, tidying, we are not governed by anxiety to escape disease, but are positively re-ordering our environment… …Within these

[273] For more on this see Jacques Monod, *Chance and Necessity*, trans. Austryn Wainhouse (London: Fontana, 1974).

[274] Bakhtin, *Rabelais and His World* p. x.

> patterns disparate elements are related and disparate experience is given meaning.[275]

Yet, according to Hyde any attempt to create order invariably fails to accommodate the complexity of that which is being ordered. [276] The forum was then perhaps always doomed to fail in this instance as it promised, but failed, to accommodate the complexity and nuance of certain aspects of the project communication. The designers were quick to exclude the unofficial message board, but Hyde suggests that care must be taken with exclusion, as occasionally the excluded may need to return:

> No order should locate its dung heaps too far from town. Then again, if dirt is the by-product of creating order, no order should willingly entertain the return of dirt unless it has some self-destructive impulse.[277]

Dirt is referred to by both Hyde and Douglas as the by-product of ordering, references to dirt are thus not literally to *dirt* but refer to anything which might be excluded from any system of ordering. When we apply this logic to the forum, we see it as an extremely well considered—but invariably—inadequate ordering of the discourse. Nevertheless, because the message board was not part of the official forum the political nature of these devices leaves the message board and forum existing in a state of perpetual irresolvable tension. Both the *unofficial* and *dirt* are considered unwanted and unimportant from within the domain of the official. In the proto-construction project we observed how the instigators of the official forum tried different modes of persuasion to stop the continued usage of the unofficial message board. Although Hyde suggests that tensional relationships should not be considered exclusively problematic:

> Out of the friendship of Ifa and Eshu (like that of Apollo and Hermes at the end of the Homeric Hymn) we get no tragic opposition, then; we get, rather, the creative play of necessity and chance, certainty and uncertainty, archetype

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[275] Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* p. 2.

[276] Lewis Hyde, *Trickster Makes This World: Mischief, Myth, and Art* (New York: Farrar, Straus and Giroux, 1998) p. 197.

[277] Ibid. p. 185.

> and ectype, destiny and its exceptions, the way and the no-way, the net of fate and the escape from that net.[278]

Like the friendship of Hermes (a mortal) and Apollo (a God), oppositions such as official and unofficial have within them the potential for *creative play* and *chance*. However, it would seem tension must exist between this binary opposition for the potential of creativity to exist. There is also the suggestion that there is no prescription for success inherent in the potential for *the way*. Equally, Hyde suggests the potential of existing for *the no-way*. Dirt has also found its way into popular literature and popular authors like Robert Pirsig would seem to be in agreement with Hyde. Pirsig cites *junk* as an important category in his creative process. Douglas suggests dirt is "matter out of place."[279] Pirsig considers his junk as matter out of place, this is brought to our attention by his reluctance to discard it; he finds it implicated in the creative process:

> The final category was JUNK. These were slips that seemed of high value when he wrote them down but which now seemed awful. Sometimes it included duplicates of slips he had forgotten he'd written. These duplicates were thrown away but nothing else was discarded. He'd found over and over again that the junk pile is a working category. Most slips died there but some were reincarnated, and some of these reincarnated slips were the most important ones he had.[280]

Pirsig is non-specific yet suggests that the junk category of this creative process is of substantial importance. Bakhtin, Hyde and Douglas also claim that there is creative potential and value in dirt and the unofficial. This potential is not specifically within the unofficial but would seem to exist within the tensions that it creates with the official. While these political forces may exist in a state of tension, they would both seem to have important functional roles to play within the proto-construction project and the process of collaboration in general.

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[278] Ibid. p. 117.

[279] Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* p. 179.

[280] Robert M. Pirsig, *Lila: An Inquiry into Morals* (Alma Books Ltd., 2006) p. 26.

4.7.3. The Relationship Between the Official and Unofficial

There are two positions that have been exposed through our review of Douglas and Hyde in this chapter. One as adopted by Mary Douglas suggests that the process of ordering is a common cultural activity and has deep association with our mastery of our environment. The other position as adopted by Lewis Hyde suggests that the by-product of ordering—such as dirt and the unofficial—is implicated in of creative opportunity. There is also the suggestion that this creative potential exists not as a harmonious relationship with the official or the ordered, but rather because of the tension caused by these oppositions.

The demarcation of territory is a primitive means of ordering, as is defining the boundary between official and unofficial and between other categorisations. This tendency to privatise is extremely evident in the writings of both Douglas and Hyde in relation to the human condition. As well as demarcation, the theme of transgression features heavily in these authors' writings, also citing it as necessary traits of the human condition. Brown and Duguid advance these positions and claim ordering and its subsequent subversion both have inherent value[281] although both do not initially seem compatible. A similar uneasy relationship existed during the proto-construction project. The official forum was a demarcation device that protected official discourse from being defiled by the unofficial—non-project related chatter being carried out on the message board—or being contaminated by other categories of communication.

In the absence of demarcated boundaries and compartments perhaps the message board facilitated this transgression, although occasional confusion was documented. Allowing the ideas of the participants to mix created opportunities and inspired moments of creativity. Even the more scientific framing of Jacques Monod contends that chance is implicated in the creative act. Which resonates with Brown and Duguid's assertion that improvisation is associated with newness,[282] and Hyde's

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[281] They argue that value and benefits depend on individual perspective and where in the process you are. For more on this see Brown and Duguid, *The Social Life of Information* p. xv-xvi.

[282] John Seely Brown and Paul Duguid, *The Social Life of Information* (Boston: Harvard Business School Press, 2000) p. 108.

claim that American Trickster figures are usually to be found at crossroads, a location that affords chance meetings. Monod also draws on the crossroads metaphor and calls what underlies the creative act “two road chance,” continuing to add weight to the argument that chance and accident are implicated in creativity.

This opportunity for accidental meeting and discovery is vastly reduced within an official structure; each compartment is defined and protected from contamination from other compartments to prevent the occurrence of chance encounter. The unofficial however has no such restrictions and the potential for a chance meeting and thus the potential for true creativity what Monod calls *absolute newness* is much higher within the randomness of the unofficial than within the ordered of the official. Within the proto-construction project, the randomness of the unofficial message board gave birth to many ideas, not all as successful as the umbrella idea, which the participants of the project chanced upon and endorsed. Throughout the construction of the project utilising the unofficial message board as a metaphorical crossroads could ameliorate the sterility of the official forum. However, we are unable to identify a prescription for successful appropriation of the two technologies, which would appear to be a result of the participants considered communicative needs and how they negotiated the usage of the forum and message board. We will take a closer look at this negotiation of the communication technologies in the following section.

4.8. NEGOTIATION OF THE COMMUNICATION TECHNOLOGIES

In this section we will elaborate further on the participants’ choice of communication technology in specific circumstances and how they negotiated the choice and usage of these technologies throughout the proto-construction project. To begin we will discuss the functional aspects of the choice of technology, secondly we will discuss the implications of politics on their choice of technology and finally we will discuss our findings in terms of effective communication.

While there were personal e-mails and meetings during the project, the two main communication tools were the message board and the forum. In the early design stage of the project we see the unstructured sequential format of the message board dominate in the absence of any other mode of communication. It was found to

be useful within the early design stage for expansive trans-disciplinary communication. Later as the project moved into construction it was still employed in a trans-disciplinary capacity but—as with the weather data example—for design changes and problem solving. At this point the message board ceased to be used for group specific communication, this moved to and became contained within the forum. The participants adopted the forum quickly for group specific communications, which benefited from the additional structure provided by the forum. Intensive and detailed communication—as in the case of the survey team discussing their video clips which we explored in the previous section—also benefited from the added structure.

4.8.1. Functional Negotiation

Functionality is the first facet of the communication technologies we will scrutinise. The message board and the forum had very different functional benefits. The message board afforded expansive and fluid discourse and the forum more intensive and detailed discourse. There were benefits to appropriating a certain mode in certain circumstances and given the choice participants seems to gravitate towards whichever technology would be most effective for a particular communiqué. This functional framing of technology is quite typical of the research that was reviewed in chapter two and it is typical of the functional language that the current construction industry adopts for framing construction and its processes. However, based on the findings of this chapter it would be misleading to suggest an association between technologies and a roles or stage of the construction process, nevertheless much of the current research does promote such relationships. The findings of this chapter suggest a choice of communicative tool and an understanding of the advantages and disadvantages of the function of each was critical in the participants' successful appropriation of them.

However, function was not the only aspect the participants had to consider when using the communication technology, tensions also emerged from the appropriation of these technologies. While the tensional facet was perhaps not as pronounced as in a typical construction project it was caused by the two communication technologies and the pressures exerted by certain participants on

others. The contemporary description of construction revealed in chapters one and two only addresses functional facets of construction and communication, it does not contain the descriptive nuance to engage with the additional facets of tension and negotiation within the design and construction processes.

4.8.2. Political Negotiation

The negotiation of political tensions of the proto-construction project had the potential to influence the participants' choice of communication technology. There was direct political pressure exerted by participants with political interests in the use of the forum. We documented instances where individuals agree to use the forum for general message posting during the process of design and construction, yet later during the focus group those same individuals acknowledge that the forum was inferior for this aspect of communication.[283]

Reviewing the literature of Bakhtin, Douglas and Hyde have revealed that however problematic the tension created between the opposing *official* and *unofficial* forces, they contribute to an environment that is more conducive to nurturing creative opportunity. Looking at the discourse surrounding the use of weather data, we see it percolate through the two communication devices and evolve from a simplistic suggestion into a highly developed idea:

> We have worked out some weather effects by premiere. These are some samples. If you have any requirements for any kind of weather effects please let us know! Posted @ 08-May-2004 03:36AM.[284]

Over the course of two days and ten posts within the privatised forum the idea evolved as far as it could within the confines of the survey team's knowledge:

> I'm thinking of making a cfml script to grab the data every half an hour for this site. But I want to know how much data you guys need. If just several

[283] One of the participants who encouraged others to use the forums general compartment later during the focus group admits to not using it. See Appendix A.1, section 13.2, message [263] for the supportive message and see Appendix A.1, section 13.4 [20:30] for the comment during the focus group.

[284] Appendix A.1, section 13.3,5.

> pieces of data on the web are useful, spending time on writing the script might be a waste of time. Posted @ 10-May-2004 12:36AM.[285]

After this the discourse needed more expansive discussion and after a few days the team chose the message board to explore the viability of this idea by engaging with other sub-groups:

> Henrik and I have been discussing the possibility of using live weather data from a site Kevin has found to modulate some sonic aspects of the installation (weather-based soundscapes being created by Pete). Kevin, have you made a script to extract the data? I'm working on a way to communicate this to Max/MSP (via Open Sound Control) and so need to know what the nature of the data will be. Could you let me know which parameters (pressure, temperature etc.) you will be sending and how often? If it updates every 30 minutes we could have a 30-minute delay and ramp slowly between values so that they are constantly changing which might be interesting. Henrik said Aragon also might be able to help with this? Thanks, Bob 10:34 AM Sun 12/05/2004.[286]

Quite literally *between* these two communication technologies the participants negotiated their collaboration, instinctively choosing the mode of communication that would be most effective. It would seem the provision of both modes of communication that facilitated fluid/expansive and structured/intensive discourse proved beneficial for the process of design and construction of the proto-construction project, even if it did cause tension within the project. Applying this to the context of contemporary construction we can then see how the appropriation of a new communication technology—such as the mobile phone—and its communicative traits might influence the established construction process and working practices. The findings also suggest that the intervention of a technology that affords such fluid communication can also influence the communicative relationship with existing official structured means for communication.

4.8.3. Effective Negotiation

We could frame the notion of effective negotiation of the communication technologies in terms of the musical and mechanical art of *tuning*. This is defined by

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[285] Appendix A.1, section 13.3.8.1.

[286] Appendix A.1, section 13.2, message [339].

the Oxford English Dictionary as *to put into the most efficient working order*. Either mode of communication would individually be sub-optimal for the entire communicative needs of the proto-construction project, whereas if both exist in a state of tension (as is the case with most systems that require tuning) they can be tuned to operate in an efficient working order.[287] Pirsig has written at length about the notion of tuning and its relevance to our engagement with technology. He has also noted its slow disappearance from our engagement with technology as we have progressed from an analogue to a digital culture. In *LILA* Pirsig argues that we are biased towards static patterns rather than dynamic ones. If our mp3 player starts to function inconsistently we are more likely to discard it and purchase a new slightly better one rather than have it repaired or tuned. What Pirsig points out is that this type of periodic change is a type of dynamic tuning although not in the traditional analogue sense of tuning an instrument or engine. Pirsig continues to argue that although the notion of tuning may be reduced in our etiquette for engaging with technology, it remains a critical component.[288]

It could be argued the participants were tuning their communicative requirement through their choice of the two communication technologies throughout the project. In *Digital Ground,* McCullough[289] contends that technology and design are fundamentally intertwined with their context culture. During the proto-construction project we observed the negotiation of these technologies and the tension they created through the investigation of several facets of the design and construction process. Functional aspects influenced participants' understanding of the project and what would be the most effective mode of communication in their specific situation, but it was also subject to pressure from political influence, negotiations and tensions.

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[287] Tuning has made its way into popular literature, a lengthy excerpt on the merits of tuning can be found in Robert M. Pirsig, *Zen and the Art of Motorcycle Maintenance* (London: Vintage, 1989) p. 22-60.

[288] The themes of static and dynamic emerge and re-emerge throughout Pirsig's narrative throughout the entire book, however there are two coherent exerts, see Pirsig, *Lila: An Inquiry into Morals* p. 148-61, 321-35.

[289] Malcolm McCullough, *Digital Ground* (Cambridge, Mass: The MIT Press, 2005).

4.9. SUMMARY: A DESCRIPTION OF CONSTRUCTION AS A CREATIVE PROCESS

In this chapter we have scrutinised the documentation of the proto-construction project with the intention of revealing an alternative description of construction as a creative process. This was in response to the limited functional contemporary description of construction that emerged from our review of the construction industry in chapter one and from the current research in chapter two. The functional dominates the contemporary description of construction; the aim of this strand of our research was to create a richer description of construction as a creative—rather than purely functional—process.

Through our documentation of this proto-construction project several facets emerged, of which *function* was one. Our findings support the stance taken by McCarthy and Wright in *Technology as Experience*; our interactions with technology go beyond function and the findings revealed additional facets of *tension* and *negotiation* influencing the process of design and construction. Negotiation was facilitated through the different technologies but the choice was not arbitrary it was influenced by—amongst other things—the functional benefits of the technology and by participants' awareness of which mode of communication would be most effective. The alternative description of construction comprises not only the functional, which dominates contemporary construction but also includes negotiation and tensional facets. These three facets will form the triad of our alternative description of construction as a creative process.

4.9.1. Function

While it was possible to tangibly establish the functional benefits of the communication technologies that emerged during this project, it was not possible to attach those communication technologies to a specific stage of the process or to a particular role within it. If we were to relate the functional advantage of the technologies to something, it was to the participants' understanding of any specific situation and the perceived effectiveness of available technology to address their communicative requirements.

The message board was implicated in expansive trans-disciplinary communication, which was quite fluid. This was more dominant in the early design stage of the project. However, the continued usage of the message board suggests that fluid communication and creative processes continued throughout the construction stage of the project. This challenges the current research and current initiatives that would rather prevent or minimise this fluidity during construction and where possible limit design to pre-construction stages of work. On the other hand the forum was more associated with intensive communication and its privatisation afforded the interrogation of details and nuance. The forum was deployed during the latter stages of the design and the construction of the project. It enabled the participants to compartmentalise and organise specific threads of communication. These threads could then be revisited or updated with ease. We cannot dismiss the popular notion discussed in chapter two that benefits are gained from having structure to assist with the orientation and organising of complex processes. However, it should also be acknowledged that the privatised structure adopted for this project also caused communication problems for the participants.

4.9.2. Tension

The functional facet of the process dominates the contemporary description of construction. However, the findings from this chapter suggest that the official/unofficial politics that emerged and the tension generated between them also influenced the construction process.

According to Bakhtin the politics of the official and unofficial are unresolved and exist in a state of tension. It is the engagement with this tension during Carnival that Bakhtin attributes to its potency as a creative event. When the forum became established as the official mode of communication for the proto-construction project the message board by its exclusion was not just another mode of communication but an unofficial mode of communication. Rather than allowing it to be appropriated by the participants, various attempts were made by the designers of the forum to marginalise the message board and encourage forum usage. However, the focus group established the message board was better suited to expansive communication than the forum, which seemed more suited to intensive communication. The finding

support Hyde's supposition that it is within the tension created by these two opposing components that creative opportunity exists.

The politics of the official and unofficial are different, the official in this case was privatised and explicitly categorical and the unofficial was not explicit but fluid. By drawing from Douglas and Hyde it would seem that binary oppositions such as this are not uncommon in the human condition and are often implicated in opportunity and creative potential. The tensions that are generated between these oppositions are not necessarily harmonious or to be resolved. Rather they are to be negotiated, and within the negotiation of such relationships lies the potential for creative opportunity.

4.9.3. Negotiation

Reviewing Bakhtin, Douglas and Hyde to scrutinise the negotiation of these oppositional forces has revealed that potential for creative opportunity exists between them. The literature also point to there being no prescription for ensuring success, Hyde describes the potential within these gaps for both the *way* and the *no-way*. Arguably the *way* was found through the participants' understanding of the proto-construction project and the communication technologies and not through prescribed structures. Participants rallied with the forum designers when they called for exclusive use of the privatised forum. Although, as the project progressed the focus group revealed these same participants continued to use the public message board. It was more effective for what Brown and Duguid term as lateral communication,[290] which the privatisation of the forum prohibited. Lateral communication they contest is typically informal and unstructured, but implicit in creativity and improvisation for problem solving. This phenomenon is also associated with the notion of *tuning*, which is defined as a system being in efficient working order. Much like the potential for creative opportunity, tuning cannot be defined through a single component but exists in the effective negotiation of at least two or more components. Perhaps it is then not a coincidence that tuning has emerged within this context of design and construction, which—as discussed in chapters one and two—is also

[290] Brown and Duguid, *The Social Life of Information* p. 111.

seeking to improve the efficiency of the components within its processes. Rather than each component being assessed individually, tuning seeks to find the optimum or most efficient working relationship. This invariably means the acceptance of imperfections in individual components, and the periodic maintenance of these imperfections to facilitate the continued effective working of the overall system, be it a motorcycle engine or a musical instrument.

Tuning is an appropriate metaphor, although there are tools and devices to assist with it, in both the mechanical and musical arts tuning remains an activity of skill. While tuning is perhaps familiar within the arts, where resonant geometry, vibration, iterative adjustment, breakage and entropy are familiar terms, they are not familiar terms within the discourse of our proto-construction project or construction in general. Nevertheless they exist and have been observed and documented within the working practices and behaviour.

This marks the completion of the first strand of the documentation, and the establishment of the three facets of *function*, *tension* and *negotiation* to our alternative description of construction as a creative process. We will use these facets in the second and third strands of the thesis to interrogate the current construction process. As outlined in chapter three the next strand of the documentation aims to document the perceptions of communication technology within the construction process.

5. STRAND TWO: THE PERCEPTION OF MOBILE PHONES WITHIN CONSTRUCTION

> The separation of the designer from making also results in a central role for the drawing. If the designer is no longer a craftsman actually making the object, then he or she must instead communicate instructions to those who will make it. Primarily and traditionally the drawing has been the most popular way of giving such instructions.[291]

> Information technologies are not yet able to bridge domains of practice with relative ease. The set up costs are high in both time and technical expertise, making wide-scale deployment difficult.[292]

In the previous chapter we established an alternative description of construction as a creative process, with *function, tension* and *negotiation* emerging as key themes. The perceptions of mobile phones in construction will be documented in this strand of the research and scrutinised through these themes. This chapter will first discuss the context in which this strand operates, by exploring some of the relevant factors regarding *communication in construction* and *communication technology within construction communication*. It will then go on to outline a structure for *the documentation of the perception of mobile phones within construction* and finally *analyse the documentation* through the lens of ritual practice as advanced by Lindsay Jones.

Turning our attention to the opening quotation by Lawson, it highlights the increasing importance of communication in the increasingly fragmented construction process. Although drawings are the primary means of instruction, communication between the participants within construction is increasingly via additional communication technologies such as the mobile phone, email and PDAs.[293] These devices are used alongside traditional modes of communication and we established in the previous chapter they might potentially influence established communication and working practices. O'Brien et al. in the second opening quotation identifies an

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[291] Lawson, *How Designers Think: The Design Process Demystified* p. 26.

[292] O'Brien et al., "Configurable Environments: A Vision for Future Project Information Technologies," in *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*, ed. Abduk Samad Kazi (Idea Group Publishing, 2005), p. 345.

[293] This refers to Personal Digital Assistants such as Palm, Blackberry and iPaq.

existing condition, where "technologies do not yet bridge domains of practice with relative ease."[294] However, there is potentially a valuable opportunity in using mobile phones—as they bridge domains within construction. As a vehicle to explore the influence of communication technologies on collaboration and communication between trans-disciplinary domains, mobile phones are of particular interest.

5.1. COMMUNICATION IN CONSTRUCTION

Office-based working practices have been subject to a variety of research initiatives, some of which we have discussed in chapter two. The working practices of on-site construction activities have not been exposed to the same extent of scrutiny. In this section of the chapter we turn our attention to communication *throughout* construction, both on-site construction processes and off-site administration processes. This section aims to reveal if the modes of communication off-site—which have been the subject of much scrutiny—are similar and thus applicable to the communication during the process of construction. We will take the *official/unofficial* relationship that emerged from chapter four and determine if such a relationship translates to communication during the on-site construction process.

5.1.1. Official Communication

There are of course *official* modes of communication within a construction project, fax, letters, meetings, e-mails[295] etc. as well as specific modes for specific instructions. *Architect's Instructions* (AI) for example are a specific type of formal correspondence used when a substantial deviation from the agreed contract is required. An AI confirms that the architect has sanctioned such deviations. Official communication during construction is unarguably grounded in the paper medium and they are a contractually prescribed means for communicating between participants. However, phone calls or face-to-face meetings occur with regularity during both on

[294] O'Brien et al., "Configurable Environments: A Vision for Future Project Information Technologies," p. 345.

[295] E-mail was not necessarily considered an official mode of communication. Until the mid 1990s it was not widely used, however during the late 1990s several landmark legal cases used e-mail as evidence during arbitration. Slowly, as it became widely used it became integrated into the official legal framework of the construction process.

and off-site construction activities, they are not paper based but are usually followed up in written form so that a paper record exists of what has been agreed during these verbal negotiations. The official communications are implicated in the legal and contractual aspects of construction. They can be used to confirm when decisions were made and are usually invoked retrospectively to identify a past event; the cause of a delay and when it was first documented during construction.

This litigious aspect to official documentation can cause it to be ineffectual in certain instances. As official and legal communications are potentially exposed to considerable scrutiny, there may be certain information during a construction project that participants may not wish to officially document. This creates omissions in the documented record of the construction process. Being paper based and having legal implications in construction, the official routes for communication can be laborious, limited and slow. However, during a construction project immediate—albeit unofficial—modes of communication exist outside this official framework.

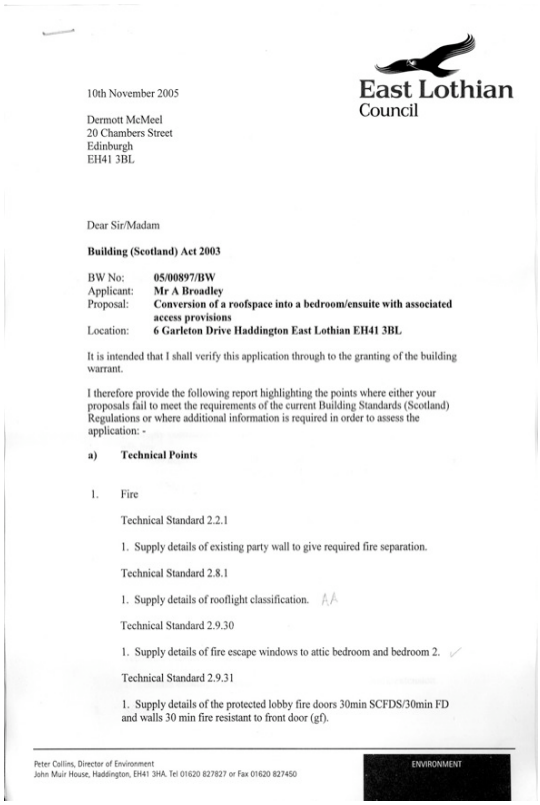
5.1.2. Unofficial Communication

We will define unofficial in the same spirit as Lewis Hyde; it is anything not defined by the official. Thus unofficial communications are any that have not been sanctioned within the official framework. They are improvised during design and construction as circumstances demand. We discovered in the previous chapter being unofficial does not preclude something from having inherent value, and during construction this may be in the form of a chance discussion or an ad-hoc sketch. In these cases there may be no retention of an official record of the communication for future reference.

In chapter four unofficial communication was revealed to circumvent official channels, it would seem that it is necessarily opportunistic and consequently outside the restrictions of official frameworks of communication. Figure 5.1 illustrates a message scribbled onto a wall, in this instance official channels of communication have been dispensed with and a decision has been made to improvise a message at the Point of Work Activity (PoWA). Improvised and ad-hoc communications like this are quite common on construction sites as they can provide immediate and effective communication. To generate an official paper document to convey this

instruction would require an individual to return to an office; write the instruction; send it to the required contractor's office, who would then forward it to the specific individuals that will carry out the work. The official route will be slower and present many more opportunities for errors to creep into the communication as it is translated between each group of people. Being outside official channels is not without risk, the instruction may not be acknowledged as it may not be seen as part of the contracted work and thus may not be recognised or carried out.

Figure 5.1 Unofficial communication on construction site



East Lothian Council

10th November 2005

Dermott McMeel
20 Chambers Street
Edinburgh
EH41 3BL

Dear Sir/Madam

Building (Scotland) Act 2003

BW No: **05/00897/BW**
Applicant: **Mr A Broadley**
Proposal: **Conversion of a roofspace into a bedroom/ensuite with associated access provisions**
Location: **6 Garleton Drive Haddington East Lothian EH41 3BL**

It is intended that I shall verify this application through to the granting of the building warrant.

I therefore provide the following report highlighting the points where either your proposals fail to meet the requirements of the current Building Standards (Scotland) Regulations or where additional information is required in order to assess the application: -

a) Technical Points

1. Fire

Technical Standard 2.2.1

1. Supply details of existing party wall to give required fire separation.

Technical Standard 2.8.1

1. Supply details of rooflight classification.

Technical Standard 2.9.30

1. Supply details of fire escape windows to attic bedroom and bedroom 2.

Technical Standard 2.9.31

1. Supply details of the protected lobby fire doors 30min SCFDS/30min FD and walls 30 min fire resistant to front door (gf).

Peter Collins, Director of Environment
John Muir House, Haddington, EH41 3HA. Tel 01620 827827 or Fax 01620 827450

ENVIRONMENT

Figure 5.2 Official communication during construction project

5.1.3. Communication and Ambiguity

As illustrated in Figure 5.1 there are modes of communication that are unofficially sanctioned in an actual construction site environment that would not be acceptable outside it. There are also models of communication illustrated in Figure 5.2 that although official and sanctioned within the administration of a construction project would not necessarily be effectual on a construction site. This can be couched in terms of the public and private themes discussed in chapter four. The letter—like the forum—is privatised communication, only seem by selected participants; not necessarily the individual charged with carrying out the work. The scribbled message—like the message board—is public and seen by any participant involved within the operational context of that place.

Figure 5.3 Official communication on construction site

Figure 5.3 demonstrates how the official/unofficial distinction can breakdown in the noise and furore of the construction site. In this example official on-site communication may not necessarily be as distinct as the official off-site communication illustrated in Figure 5.2. The markings in Figure 5.3 (orange circles sprayed onto the wall and highlighted here with arrows) are subtle markings and in stark contrast to the obvious unofficial communication in Figure 5.1. The orange circles in Figure 5.3 are however *official* site markings; they are fixed levels set by a survey engineer, which will be reference levels used for calculating various dimensions throughout the construction of a building. However they are difficult to identify and in this instance they are made even more ambiguous by their proximity to graffiti.

During the process of construction we see the *official* communication in Figure 5.3 being almost indistinguishable from the graffiti that it is proximate to. To be able to distinguish between these would require contextual knowledge. Similarly the *unofficial* ad-hoc communication illustrated in Figure 5.1 scribbled at the PoWA is arguably an important—although not official—communication containing an important instruction: LEAKS PLEASE FIX. As illustrated in Table 5.1 Administration Categorisation of Official/Unofficial, this suggests a distinctive difference between conceptions of *official* and *unofficial* communication found on and off construction sites.

	Official	Unofficial
On-Site	Drawings Ad-Hoc Markings Verbal Instruction	Ad-Hoc Markings
Off-Site	Drawing Letters	Verbal Instruction Sketches

Table 5.1 Administration Categorisation of Official/Unofficial

During operational on-site construction the distinctive official/unofficial communicative categorisations seem to blur. While a drawing is seen as official in both the context of on and off-site construction, a verbal instruction is not. A verbal instruction would be executed within the context of a construction site but within the off-site construction administration domain it would be confirmed officially in writing before or while being executed.

The review of communicative modalities during construction in this section suggests that the official and unofficial distinctions are applicable to off-site office-based working practices during construction. However, on-site communications during construction become increasingly complex and blur this distinction in the absence of intimate site knowledge. This will have ramifications for this thesis as perceptions of effective communication may differ considerably between participants based on and off-site.

5.2. COMMUNICATION TECHNOLOGY WITHIN CONSTRUCTION COMMUNICATION

In this section we will look closer at issues affecting communication technology within the construction process, including access to communication technology, the implications of using mobile phones and how they might be employed as a catalyst for discussion within this research.

5.2.1. Access to communication technology

From the review of current research in chapter two it is suggested the design and implementation of proprietary communication technological devices “fails to

live up to expectations,"[296] because as suggested by O'Brien et al. "the set up costs are high in both time and technical expertise."[297] Most of the devices currently in use are specially modified handheld computers or Personal Digital Assistants (PDA), as discussed in chapter two the usage of these devices is restricted to specific roles usually focused on management and monitoring activities during construction.[298] These communication technologies do not then facilitate the cross-disciplinary benefits of communication as explored in separate research projects in chapter two by Burry[299] and by Cushman.[300]

We have discussed in the previous section how different participants may have different perceptions of a single mode of communication. Consequently, different sub-groups of participants may develop selective conceptions of the role of a device and whether or not it has value to them. However, mobile phones are used by almost everyone within the construction process and have the potential to provide a broader insight into the differences in perceptions and the operational influence of communication technology within this trans-disciplinary capacity.

5.2.2. Mobile phones

It has already been discussed that disciplines within the construction process use different modes for communication such as CAD drawings/models, letters and e-mail. These are often interrogated within research from the perspective of a

[296] For more on this see Peansupap and Walker, "Factors Enabling Information and Communication Technology Diffusion and Actual Implementation in Construction Organisations."

[297] For more on this see chapter 18 of Kazi, ed., *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*.

[298] Examples from COMIT illustrate Stent a large Piling Company have developed a handheld computer, specifically and solely to be used by site engineers to monitor piling. OPCO Construction use PDAs with a 'snagging' software and the facility to print of barcodes for the procedure for recording and correcting defects. For more on this see COMIT, *Current Status of Mobile It* ([cited).

[299] For more on this see Burry, "Digitally Sponsored Convergence of Design Education, Research and Practice".

[300] For more on this see Cushman and Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach."

particular domain.[301] In doing so these domain-specific technologies are unsuitable for investigating the relationships and operational implication of technologies—like mobile phones—that affect the communication channels between participants and domains within a construction project.

In this section we have discussed how certain technologies receive a very limited deployment on construction sites. Where they are deployed they are usually restricted to specific roles and even specific working practices such as *snagging*.[302] However, mobile phones present an opportunity for research not afforded by these bespoke technologies. There is a great deal of functionality available in the most basic of current mobile phones. They are also familiar to participants within construction and little or no training is required to use them. They are widely deployed already and well established within the working practices of construction both on and off-site. Mobile phones present an opportunity to focus research on the trans-disciplinary aspects of communication technology and the influence that technology exerts on on-site operational construction activities.

5.3. THE DOCUMENTATION OF PERCEPTIONS OF MOBILE PHONES IN CONSTRUCTION

This section will outline how we will document the perceptions of mobile phones within construction. It will clarify which aspects of construction and which participants within construction will be the focus of this documentation. It will also clarify the precise aim of this strand of the research and the method that will be used to achieve it.

5.3.1. The Source of the Documentation

This second strand of the documentation will document the perceptions of participants who are involved in the construction process, focusing on their use of mobile phones. As we have already stated we are attending to trans-disciplinarity in construction and we will be including in this documentation perceptions from

[301] In chapter two we discussed how a CAD model was used to approximate the virtual construction of the building. This specific technological function might only be used by a very small and select group within an overall construction project.

[302] This has also been discussed in chapter two.

participants involved in a wide range of activities, such as directors, managers, designers and contractors. This will allow us to document a broad range of perceptions from participants that are involved across the entire spectrum of construction activities.

Chapter two revealed over 90% of the UK construction industry consists of contractors who employ no more than thirteen people. This large section of the industry is largely omitted from the current body of research, which usually focuses on large construction organisations. By including this section of the industry this research includes a large percentage of participants that are actively involved during on-site construction activities as well as those involved off-site in administrative activities.

5.3.2. The Aim of the Documentation

Earlier in this chapter we have discussed communication within the construction process and the different modes of communication that are active on-site and within the off-site administration of a construction project. We revealed how official and unofficial communications can pick-up additional layers of complexity within the context of a construction environment. We also discussed how domain specific use of communication technology could produce different opinions of them across disciplines within construction. The aim of this second strand of the documentation is to record the participants' perceptions and reveal the complexity that's exists in participants reading of mobile phones within construction.

5.3.3. The Method of Documentation

Given the busy nature of construction and the potential difficulty in organising participants it was decided to document this aspect of the research using semi-structured interviews.[303] The semi-structured interview format would allow for more in-depth documentation than adopting a postal or online questionnaire, as it would allow us to arrange a meeting at the convenience of each interviewee. It will

[303] As discussed in chapter three the author was an interviewee in a research project that used semi-structured interviews. It proved very effective both as a means of gathering data from busy individuals and as a means of obtaining insights from individuals.

enable the interviewee to elaborate on a topic if they wished to do so and the interviewer could elaborate on a question or seek further clarification from the interviewee if so desired.

Semi-structured interviews were carried out with a variety of participants with different roles in the construction process. We will outline these roles now, beginning with the *Construction Organisation Director* (COD). These individuals are typically no longer directly involved in specific projects except at a very superficial level. However, they are likely to have influence over policy making within large construction organisations and influence the sub-contractors that will be sub-contracted to carry out detailed aspects of the construction project. Next we will interview *Designers*, the responsibility of an architectural, mechanical or structural designer does not end as construction starts, they will be involved throughout the construction process as the design evolves and they will also be interviewed within this strand of the research. The next role that is of interest is the *Site Manager* (SM), individuals in this role are usually under the employment of large construction organisations, although they are implicated in project administration they are much closer to the onsite construction activity and usually based on a specific construction site for the duration of a project. Most actively involved in on-site construction activities are the *Sub-Contractor* (SC), this terminology is used to encompass both sub-contractors who would be employed by a large construction organisation and small domestic sized contractors who undertake smaller domestic scale projects. This term will also include specialist contractors who specialise in specific components of construction such as providing glazing or staircases. These participants we consider as part of the spectrum of roles as illustrated in Table 5.2 Organisational/Operational spectrum, some—such as designers—are engaged in predominantly (but not exclusively) organisational roles within the construction process and some—such as sub-contractors—are engaged predominantly but not exclusively in the operational role of actual construction.

Designer	Construction Organisation Director	Site Manager	Micro-Contractor

Organisational Roles — Operational Roles

Table 5.2 Organisational/Operational spectrum

Semi-structured interviews were carried out at locations convenient for the interviewee, in total 14 people were interviewed with some prearranged and some opportunistic. A questionnaire was used as the basis for the interviews;[304] this had been designed to gather information regarding the interviewee and their role within construction. It will also gather quantitative data regarding their usage of mobile phones, qualitative perceptions of mobile phones and the benefits and problems they cause within their specific role. The interview transcripts can be found in Appendix A.2.

5.4. ANALYSIS OF THE PERCEPTION OF MOBILE PHONES

In this section we will scrutinise the interview documentation; we will periodically draw from Lindsay Jones who has written extensively on ritual practices in architecture and construction to shed light on the perceptions that were documented. Jones alludes to the fluid aspects of construction:

> Where bricks and beams are being laid in place, and the physical shapes as well as the meanings are very clearly being transfigured and rearranged, we find the quintessential instantiation of that which we already knew about human apprehensions of architecture—that they are fluid, multivalent, interactive, and productive, and this is transformative in both the human actors and the built form.[305]

[304] The questionnaire can be found in Appendix A.2, section 14.1.

[305] Lindsay Jones, *The Hermeneutics of Sacred Architecture: Experience, Interpretation, Comparison*, 2 vols. (Cambridge, MA: Distributed by Harvard University Press for the Harvard University Center for the Study of World Religions, 2000) p. 263.

This continues to reinforce the challenge to rigidity that has been building in previous chapters in this thesis. Resisting the notion that construction can or should be a rigid linear process of fabrication and assembly, the second opening quotation from Lewis Hyde reminds us that rigid representations—what Hyde calls *models*—are often inadequate:

> If dirt is matter "out of place," if it is what we exclude when creating order, then this and other stories about tricksters and dirt must also speak to the sterility that hides in most human systems and design. The models we devise to account for the world and the shapes we create to make ourselves at home in it are all too often inadequate to the complexity of things, and end up deadening by their own exclusions.[306]

We apply this critique to the drawings, documentation and other models used to represent and communicate within construction and draw on Jones and his critique of operation and orientation rituals within architecture to help explain this resistance to fluidity within construction, which was observed amongst some of the interviewees. We will analyse the perceptions of participants through the themes of *function, tension* and *negotiation*, which emerged from the first strand of the research.

5.5. FUNCTION

In this section we will explore what functions of mobile phones are being used and how they are perceived as being used. Later in chapters ten and eleven of this thesis these perceptions will be compared with the actual usage of mobile phones during construction.

The interviews suggest that similar perceptions exist across the spectrum of participants regarding how mobile phones function within construction. Those engaged in activities both on and off-site from construction organisation directors through to sub-contractors suggested the contact-ability is the main benefit gained from appropriating mobile phones within their role. However, the documentation revealed some reservations from participants engaged in organisational activities, such as construction organisation directors and site managers. They perceived mobile

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[306] Hyde, *Trickster Makes This World: Mischief, Myth, and Art* p. 179.

phones as having potentially negative effects on established organisational activities as the following quote suggests:

> A site manager should have two A4 pages of 'to do' tasks... he'll never get through them all but by lunchtime you want to be thinking about what you need in order to get ready for tomorrow. After all everyone thinks they are the most important at that time when they contact you, the site manager has to be thinking ahead, thinking about tomorrow.[307]

Interviewees used the most basic functionality of mobile phones and only a small percentage of those interviewed used any functionality beyond making phone calls and sending SMS text messages. The main concern for the interviewees was that their mobile phone was robust and reliable for use in the demanding construction environment. Although only a small amount of mobile phone functionality was utilised by the interviewees, the dynamics of mobile phone usage was quite complex. For example a call may or may not be answered based on several factors, including:

- Knowledge of whether the caller is likely to contact someone else if they are unable to make contact.
- Knowledge regarding the subject of the call and whether it will be potentially quick or lengthy.
- Knowledge of the role of the caller (potential/existing client or product representative).

Different interviewees had different criteria depending on the specific circumstance they found themselves in. To quote from one interview:

> I wouldn't answer work related calls if they were from time consuming individuals, I would give them a call back when I had more time on my hands. If it's a contractor you should answer whatever, as they are the ones who give you work. If I don't recognise a private number I usually won't answer at night, I'd get back to them in the morning.[308]

Although only a limited amount of the functionality available on mobile phones is actually utilised by the participants within construction, patterns of usage

[307] See Appendix A.2, interview 11.

[308] See Appendix A.2, interview 11.

are not easily identified. Usage was dependent on many contextual factors including caller ID, location and specific activity. It was also dependent on the interviewees' subjective perspective on the situation and local knowledge. This brings added layers of complexity and fluidity to what—on the surface—seems a strictly functional application of a communication technology. In the following section we will use the themes of operation and orientation as exposed by Jones to explore this complexity of participants' perceptions.

5.6. TENSION: OPERATION/ORIENTATION

In this section we will look at the relationship between the *operational* and *orientation* tensions of the design and construction process. Jones has commented on notions of operation and orientation ritual in architecture and we will discuss their influence on working practice before exploring the relationship and its relevance within the context of construction.

5.6.1. Operation

In this section we focus attention on the *operational* politics of construction that were revealed during the documentation. Operational politics seem to be driven by the perceived need to make progress during the *making* of a building. This is typically achieved by taking abstracted graphical drawings, quantities and schedules, then converting these abstractions into reality. This does not always go exactly as planned, as Jones asserts in his opening quotation "where bricks and beams are being laid in place, and the physical shapes as well as the meanings are very clearly being transfigured and rearranged… they are fluid."[309] This suggests that there is something inherently fluid about the nature of operational activities during the construction process. They are unlike orientation activities, which rather than being fluid are highly prescribed. Jones claims they are designed to appear harmonious and thus instil confidence and legitimacy in the intended construction project.

The documentation that has been gathered during this strand of the research suggests that unlike orientation, operational aspects of construction necessitate the

[309] Jones, *The Hermeneutics of Sacred Architecture: Experience, Interpretation, Comparison* p. 263.

participants addressing specific details of particular situations, which orientation activities do not. For example a tiling sub-contractor suggests there may be several ways of tiling a wall or floor, and it is necessary to confirm with the client exactly how they would like the border or centrepiece tiled. This detailed information is not usually contained in drawings:[310]

> When you are coming to details, where the client wants a border or a centrepiece or a particular pattern in the tiles, you can just give them a call and find out or get them to come round. [311]

The sub-contractor who specialises in stair design and manufacture also finds it necessary to discuss specific details with clients or staff when his product is going to be constructed on site:

> I got a call where the stairs weren't fitting, as they should because the builder had moved a wall to fit a door in. I went and had a look and with a few changes it would fit. I wouldn't have just put the stairs in you know… I had to make them look right.[312]

These examples demonstrate to maintain progress discussions and negotiations must occur. This is not representative of flaws in the planning or orientation aspects of these construction projects, although that would seem to be the dominant perception of participants such as construction organisation directors and site managers engaged in orientation activities. Based on the documentary evidence we would suggest negotiation is necessary to resolve the specific details of the relationships that have been established during the pre-construction orientation process of designing. These details may not have been totally resolved during design for a variety of reasons; it may not have been financially practical to design the tile pattern in the amount of detail required. Alternatively, as one interviewee suggests there may be little benefit in designing to such a level of detail:

> Hard to avoid changes because the client comes out and wants to move the fireplace, or they are planning on a potbellied stove rather than a standard fireplace, that might not be in the drawings and your chimneybreast would

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[310] At least not in typical domestic scale construction projects. Larger budgeted or more specialised designs can have interior room elevations, covering materials and patterns.

[311] Appendix A.2, interview 8.

[312] Appendix A.2, interview 4.

> have to be very different. Or they want to make a room bigger and you have to accommodate them if you can. After all it's their house.[313]

The above quote from the tiling sub-contractor regarding the client suggests negotiation during on-site construction operation is necessary to clarify information not included in the orientation drawings. The previous quote from the director and the staircase sub-contractor suggests negotiation is often necessary to resolve a change that occurred between what was designed off-site during pre-construction and what was actually constructed on-site. These insights bring the importance of client's values to centre stage. It draws attention to client participation beyond the design stage and challenges propositions that attempt to intensify design resolution and increase the rigidity of the construction process. There are only cursory references to clients in much of the literature, usually within a context of their involvement in the design process. In spite of this our findings suggest there is a continuing disparity between client's conception of the designed and realised object. A disparity that interviewed sub-contractors seem particularly sensitised to.

We will frame these observations in operational activities in terms of the *gap*; that needs to be either bridged or filled. The term *gap* was used by one of the interviewees who cited an example of a dormer window in the roof of a house causing an undesirable *gap* in the plastering and roofing trades. In this example one trade is unable to complete and must wait for an interim trade to be completed before they can finish their work package:

> The plasters might accidentally break a few roof tiles or stain them with plaster and then when the roofers return they're complaining that it has to be cleaned or repaired and it's not their responsibility, if we can avoid that we will.[314]

In the above example the interim plastering trade causes a gap in the roofing trade and in the plastering process they damaged the other trade's work, which must be repaired. This sort of negotiation between sub-contracts in a complex construction situation can be contentious as each sub-contractor is trying to complete their

[313] Appendix A.2, interview 10.

[314] Appendix A.2, interview 1.

specific interim or work *package* as these sub-contracts are occasionally described. This example illustrates how the individual interim operational goals of the sub-contractors can lead to conflict and potentially impede the main operational goal of timely completion of the overall construction project.

Although operational politics would seem to be driven by the maintenance of progress during the construction process, this section has demonstrated that interim operational progress of sub-contractors does not necessarily translate directly into overall project progress, as the desire to finish a sub-contracted package and leave might not be in the overall interest of the co-ordination of the project. Also in this section the nuances and complexity of the specific operational situations that can arise have been brought to centre stage by interviewees that have suggested it is necessary to negotiate, particularly in regards to the discrepancies between clients' imagined and realised buildings. Thus successful operational on-site progress seems contingent not only on pre-construction planning but also in negotiation and fluidity during the construction process.

5.6.2. Orientation

In this section we interrogate *orientation* processes within construction. The politics of orientation seem to be driven by the perceived desire to maintain organisational structures—such as accurate drawings, schedules and budget—during the making of a building. Such aspirations are well founded as they assist the participants to orientate their work in relation to others during construction and retrospectively provide a map of the process of construction. According to Jones, there are additional benefits—beyond organising—from applying orientation practices. Excellence in architecture and construction, is historically associated with harmony, consequently—according to Jones—homologized organisational structures that portray construction as harmonious also engender confidence in the building program:

> Mannerists who validate an atmosphere of doubt, conflict, and tragedy, have nonetheless tended to equate "excellence" in architecture with building programs that exude harmony, regularity, balance and symmetry.[315]

This is a stark contrast to the operational politics of construction that have been revealed here, which are reliant on negotiation and fluidity. However, it provides an explanation for the tension between the two political forces. The presumption of harmony and regularity that is inherent in orientation processes such as architectural or engineering drawings potentially clash with the fluidity that is inherent in operational processes. Although orientation processes make a valuable contribution to construction, Hyde exposes a weakness in the use of homologized systems and argues they are inadequate:

> The models we devise to account for the world and the shapes we create to make ourselves at home in it are all too often inadequate to the complexity of things, and end up deadening by their own exclusions.[316]

Within construction, participants orientate their activities within the overall construction process using many types of models such as drawings, schedules and bills of quantities. These orientation tools are used throughout the construction process to account for the intended building. Without these orientation tools there would be little to enable participants to co-ordinate their work with each other, and construction would be potentially chaotic. However, as suggested by Hyde there is a risk these models "deadening by their own exclusion,"[317] thus both the fluidity of operational activities and the rigidity of orientation activities provide important contributions to the overall process of construction. This is perhaps illustrated by an example discussed during an interview, where a drawing contains the specific details of a building's fireplace and chimney requirements, yet fails to represent the complexity of the client's plans for the fireplace.

> Changes, hard to avoid changes because the client comes out and wants to move the fireplace, or they are planning on a potbellied stove rather than a

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[315] Jones, *The Hermeneutics of Sacred Architecture: Experience, Interpretation, Comparison* p. 30.

[316] Hyde, *Trickster Makes This World: Mischief, Myth, and Art* p. 179.

[317] Ibid.

> standard fireplace, that might not be in the drawings and your chimneybreast would have to be very different.[318]

While obviously not without shortcomings, orientation tools such as the RIBA Plan of Work, drawings, bills of quantities etc. that are used within construction allow participants to see the bigger—albeit abstracted—picture of a construction project and locate themselves within it. To achieve this, mechanisms for orientation within construction are necessarily general and like any language of communication they are based on standards. Those standards may be graphical conventions for drawings or a specific format for the organisational arrangement of a bill of quantities. These standard documents are useful because they can be understood by various disciplines during the construction process and used as points of reference for orientation and co-ordination. Within the context of contemporary construction, the more specialised and esoteric a system or language becomes—as in cases of bespoke devices used on construction sites as discussed in chapter two—the less applicable they will be within the wider construction context. Consequently the less effective they will be as communication devices.

We turn our attention for the moment to the fragmentation of contemporary construction, the increasing number of sub-contractors involved and the implications mobile phones may have within this context. As we have discussed Hyde suggests orientation tools and systems are general and thus imperfect.[319] However, this is necessary so that they—as Jones contests—convey harmony between their components. We have found mobile phones actively used within construction to help maintain harmony by ameliorating the brittleness inherent in these rigid systems of orientation. An interview with a site manager revealed that orientation of a construction project is not as rigid as project plans and schedules would imply. He cited examples of using his mobile phone to contact sub-contractors to ensure the project was proceeding as anticipated, if it was not then the project planning could be modified:

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[318] Appendix A.2, interview 10.

[319] Hyde discusses the tendency of systems to approximate, and consequently to exclude ambiguous content. For more on this see Hyde, *Trickster Makes This World: Mischief, Myth, and Art* p. 179.

> Checking on progress, asking for requests (materials or information) or confirming attendance on site at a specific future date to maintain the construction schedule.[320]

Sub-contractors also found mobile phones benefited orientation aspects of their work.[321] Many of these sub-contractors may have teams employed on several different construction sites and they too ensure that projects are progressing by co-ordinating their work through the use of mobile phones.

In this section with the help of Hyde and Jones we have focused on the orientation processes and orientation tools of construction. The politics of orientation demands it exudes harmony in the form of clear co-ordinated drawings and schedules. Throughout a construction project these orientation tools are maintained and should continue to reflect its harmonious state. This is the view of participants who are predominantly involved in orientation activities, such as construction organisation directors. Conversely, participants who are involved mostly in operational activities, such as sub-contractors, presented a less harmonious and more fluid perception of construction. Mobile phones are implicated in the maintenance of these orientation activities as they could quickly be appropriated to overcome weaknesses in orientation systems by negotiating the unresolved details that allow these systems to appear harmonious.

5.6.3. Operational/Orientation Tensions

In this section we will look at the relationship that exists between the orientation and operational politics that have been discussed in the previous sections and how mobile phones are implicated in this relationship. We will continue to draw from Hyde and Jones to understand the tensions and forces that exist between these two different aspects of construction.

The focus in section 5.6.1 on operational processes revealed a bias towards fluidity and negotiation for maintaining progress during construction. The focus in

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[320] Appendix 2, interview 2.

[321] This was predominantly by sub-contractors who were semi-autonomous and may have several teams of workers on several sites. The director or boss in these cases was found to use a mobile phone to make decisions and organise quickly. See Appendix 2, interview 6, 7 and 10.

section 5.6.2 on orientation processes revealed a prejudice towards the maintenance of organisational tools and the maintenance of harmony. Although the goal of all participants within both these domains of activity is to complete construction, the method by which that goal is achieved is distinctly different for each. For operational activities it is through discussion and negotiation, for orientation activities it is through maintaining harmony. As we have explored in the previous sections, both aspects make a valuable contribution to the process of construction. The operational and orientation tension also resonates with the public and private tension that emerged in the first strand of this research. In both cases compartmentalisation and structuring the discourse resulted in benefits. However, valuable unstructured and fluid negotiation was often found close to the structured discourse. Both are fundamentally quite different approaches to communication and their proximity to each other causes them to occasionally come into conflict, as we will see in an example conveyed by one of the interviewees.

In this example[322] the director of a small sub-contacting company that specialised in stair manufacture was contacted directly by an employee who was on one of their construction sites installing a set of stairs and had identified a shortage of—and immediate need for—nails. The staff member used a mobile phone to make the phone call and he contacted the director directly on his mobile phone, at the time the director was driving and took the call via a hands-free device. Although the director confirmed that the nails would be ordered, he was unable to make a note of the conversation and subsequently forgot. The following morning while driving, the director recalled the urgent need for nails and immediately contacted the main office via mobile phone and requested that they start the appropriate procedure for the ordering and delivery of nails to the construction site. That afternoon upon returning to his office the invoice was on his desk from the supplier confirming the order and delivery.

Framing this example in terms of the processes of operation and orientation, it illustrates how the operational goal of the employee—to maintain progress—was

[322] See Appendix A.2, interview 4.

achieved through contacting the director. In doing so he actually circumvented organisational processes that would have been put into effect had he contacted the office and which arguably would have been more effective and potentially resulted in earlier delivery of the nails. In this example we also see the director re-establishing the orientation systems by contacting the office and initiating the appropriate process to order the nails. Mobile phones are implicated in the directors' maintenance of orientation activities and in the employees' operational activities.

Within the documentation gathered in this strand of the research we discovered a noticeable difference in opinion towards mobile phones between participants active within orientation activities such as directors and site managers, and participants active in operational activities such as sub-contractors within the construction process. As discussed previously those who are predominantly involved in administration and organisational processes within construction such as directors are implicated in the politics of orientation and tend to have negative perceptions of mobile phone usage. Whereas those involved predominantly on construction sites that are implicated in operational processes such as sub-contractors, tend to have positive view of mobile phone usage. The negative views held by participants implicated in orientation processes are based on the presumption that mobile phones undermine these orientation activities. This would seem to be an accurate reading of the situation based on the previous example where ordering nails using a mobile phone did undermine orientation processes. It should be noted that the director also used the mobile phone to re-establish the orientation activity and while participants engaged in orientation processes may have negative perceptions of mobile phones they would seem to use them occasionally to positively influence their orientation activities. On the other hand participants implicated in operational processes perceive mobile phones more positively. In the example, nails were ordered through the appropriation of a mobile phone and it effectively served its purpose, even though it also undermined the orientation aspects of the project.

In this section we have focused on the relationship between operational and orientation processes within construction and how mobile phones are implicated in that relationship. The documentation revealed that although the goal of building

construction of these two processes may be the same, the method by which different participants who are engaged in these processes go about achieving that goal is varied and can create tension. However, both the operational and orientation aspects make valuable contributions to the construction process. Mobile phones were implicated in both these aspects of construction and although there was occasional conflict, mobile phones were used effectively to minimise the negative effects of these tensions. The type of usage afforded by the mobile phone resonates with the fluidity of operational processes and was clearly more positively received by participants sedimented in operational processes. We also revealed that mobile phones do not resonate with the rigid orientation processes within construction and they are negatively perceived by those implicated in orientation processes. However, as we shall explore in the next section the documentation collected suggests that mobile phones are used to negotiate the tensions between these two political forces.

5.7. NEGOTIATION

In this section we will focus our attention on the views held by the different participants in construction regarding *negotiation* during construction and how mobile phones are implicated within it. We found that perceptions of negotiation vary across the spectrum of roles involved in construction. The participants implicated in off-site orientation activities of construction seem to dismiss negotiation and mobile phones, whereas those implicated in on-site operational activities seem to consider negotiation as part of the operational process and embraced the mobile phone and its influence on this aspect of their role. Firstly we will discuss negotiation as it has emerged in this chapter, in terms of the previously discussed notion of the *gap*.

5.7.1. The Gap

Where we have found participants within construction negotiating or appropriating mobile phones we have found *gaps*. Either gaps between the abstracted drawing and the reality of construction as illustrated by a sub-contractor

interviewed,[323] or gaps between components as in the case of the staircase[324] that we discussed previously in this chapter. In the staircase example the director of a company was informed a staircase did not physically fit in its designated location on a construction site. Inspection of the site revealed the main building contractor caused it, having moved a doorway during construction. The situation was successfully resolved, but only through discussion and negotiation with the building contractor. This was a physical gap to be negotiated, gaps can also be knowledge-based and must be bridged for the project to progress. We also discussed the industry's oversight regarding the importance of negotiating the gaps within clients' perceptions of a real and imagined building. There may be various ways to bridge a gap, although it seems to be through the act of negotiation that successful bridging is achieved.

Mobile phones are implicated in the negotiation of this gap, rather than being superficially grafted onto the construction process they would seem to be woven into negotiation. This strand of the research asserts that negotiation is an important working practice within construction to address and resolve gaps between orientation and operational aspects of construction, which could otherwise become problematic.

5.7.2. Negotiation and Orientation Activities

While documenting the perceptions of participants predominantly engaged in orientation activities within construction we have discovered they hold negative perceptions of negotiation. This was perhaps most evident in the case of a construction organisation director:

> Dormer windows add approximately £1000 of cost to a house, now sometimes you need them but you have to use them sparingly, they also create a gap in the trades ideally you want one visit from a trade and then they move on. We try and avoid gaps in trades. The plasterers might accidentally break a few roof tiles or stain them with plaster and then when

[323] Appendix A.2, interview 10. The builder interviewed described how a drawing might contain graphical information not representative of the clients' intentions. Having experience of this relies—in part—on discussion and negotiation with them as the building progresses.

[324] Appendix A.2, interview 4.

> the roofers return they're complaining that it has to be cleaned or repaired and it's not their responsibility, if we can avoid that we will.[325]

In this example we can see the interviewee associates negotiation with conflict and delay. The underlying implication is that building designs might be influenced by orientation forces, through attempts to eliminate gaps and the need for negotiation.[326] In this example there is perhaps a blurring of the orientation/operational domains of activities. The perceptions of the construction organisation director are sedimented in harmonious orientation activities, but could potentially influence the purging of negotiation from fluid operational activities during the construction process.

Even though participants involved in orientation activities perceived negotiation as something to be expunged from operational construction, we found these participants also using mobile phones to negotiate gaps. However, their usage was quite clandestine as it was usually to address shortcomings in orientation processes or systems. Leaving little trace of its involvement, the mobile phone helped maintain the illusion of harmony within orientation practices.

5.7.3. Negotiation and operation activities

Conversely we discovered through the documentation where participants were predominantly engaged in operational activities—such as sub-contractors—they assigned a much higher value to negotiation. For example some want to negotiate prices of materials, thus preferring communication by phone or face-to-face. Some were aware of the potential for gaps between the graphical drawings and the clients' perception, so their operational activities included periodic negotiation to ensure an accurate representation of the clients' wishes. The ability to contact other participants or colleagues with expertise was suggested by some interviewees as being valuable during operational construction activities for the maintenance of the progress of a construction project:

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[325] See Appendix A.2, interview 1.

[326] The interviewee intimated as much during the interview.

> If I was called out because a boiler was broken or I was having a hard time installing one or getting it to work I'd make a few calls to a few other plumbers. You see there's a good chance that one of them has come across this boiler or this problem before. So a few minutes on the mobile could save you a few hours of twisting with a boiler.[327]

Within operational working practices we have seen the mobile phone enhance the potential for resolving problems and negotiation of various gaps between operational and orientation activities during the construction process. Mobile phones are a tool that provided immediate access to the possibility of negotiation. They have become a valuable tool to those participants implicated in on-site operational activities that involve negotiation.

In this section we have explored perceptions of negotiation in construction and the role of mobile phones within it. We have found that negotiation could be seen as being key to operational aspects of construction. However, this negotiation conflicts with the harmonious nature of orientation activities within construction, and the participants engaged in orientation activities attempt to purge negotiation from the construction process. Mobile phones enhance the process of negotiation within construction and thus they enhance operational activities within construction. Mobile phones are also associated with fluidity and negotiation, which conflicts with the rigid and harmonious nature of orientation activities and thus they are perceived as weakening orientation and planning during construction. However, when this occurs we have seen mobile phones appropriated to support and repair the same orientation structures. The findings suggest mobile phone usage is implicated in both the fluid operational and harmonious orientation aspects construction.

5.8. SUMMARY

This chapter focused on interrogating the documentation that was gathered by interviewing participants involved in the construction process to increase our understanding of the perceptions held by participants involved in construction with regards to mobile phones. We looked at these views under the themes of *function*, *tension* and *negotiation* and found under the functional theme there were similar

[327] Appendix A.2, interview 11.

perceptions but under the others we documented notable differences in perceptions between participants based on construction sites and those based off construction sites.

5.8.1. Function

The findings suggest that participants use a limited amount of the functionality available on mobile phones, phone calls and SMS messaging are the only functions used. Although a small number of the interviewees used the alarm clock and calculator functionality, none of the interviewees used Bluetooth, the Internet or the calendar functionality. This suggests that the perceived returns from sophisticated functionality is not necessarily proportionally beneficial, or perhaps in the clamour and noise of the construction site it is only the intuitive and easily accessible functions that are practical to utilise.

Although the functionality utilised by the interviewees was limited, the ways in which mobile phones were used was very complex and often was related to the specific nuances of any particular situation. Calls would be answered based on contextual knowledge of the caller, the subject or the callers anticipated actions if the calls were not answered. Generally, participants' perceptions suggested the contact afforded by mobile phones through calls and SMS texts enhanced their ability to carry out their role within construction. Participants implicated in orientation activities held strong opinions regarding mobile phone usage by site-based participants, believing them to undermine orientation aspects of the construction process. However, as we shall see in the next section this could be in part attributed to the historical tension that exists between the operational and orientation politics of construction.

5.8.2. Tension

The tension that emerged from the documentation of participants' perception was framed in terms of *operation* and *orientation*. The interviews revealed participants based on-site and predominantly involved in *operational* construction activities held a positive perception of mobile phones. This was attributed to these roles being grounded in the practice of negotiation and discussion during the

construction process. The impromptu contact afforded by mobile phones increased the potential for contact and thus enhanced these activities and roles.

We also discovered participants who were based off-site and predominantly involved in *orientation* construction activities held a negative perception of mobile phones. This was attributed to these roles being grounded in the maintenance of harmony during the construction process. Impromptu mobile phone usage is perceived as undermining orientation activities or implying these activities are somehow insufficient and thus undermine their authority. Through this the privatised nature of mobile phone contact and the absence of any trace of communication is brought to our attention. The benefits of public discourse have been discussed in chapter four and although we can draw parallels between the structured and unstructured discourse in both strands, mobile phones—unlike message boards—are private. This can causes gaps in the documentation, which can be problematic for project orientation, as we have discussed earlier in this chapter. There is the suggestion within the documentation that participants in orientation roles use mobile phones to maintain organisational procedures and systems. However, this strand of research was focused on perception and not explicitly usage of mobile phones, which will be addressed in the third and final strand of documentation.

5.8.3. Negotiation

The documentation exposed different perceptions amongst participants regarding *negotiation* during construction. The site-based participants embraced negotiation, with many interviewees' suggesting a reliance on negotiation to maintain progress during construction and to ensure that the finished building would meet the clients' expectations. It would appear from the documentation that negotiation is a key part of the working practices of these participants during construction.

There has been the suggestion within the documentation that off-site participants as well as on-site participants engage in negotiation. On-site participants used it openly as part of their working process and off-site participants use it clandestinely to maintain their orientation and organisation working practices. In both these instances mobile phones have been used to negotiate gaps. Gaps between

the designed and the constructed, as is often the case when they are employed in operational circumstances, or gaps in organisational systems, when they are employed in orientation situations. While different participants may hold different perceptions towards the practice of negotiation, the documentation suggests they all invoke it to positive effect within the working practices of their particular domain of activity. Continuing the theme of the gap into clients' values, we see evidence that clients can drive change throughout construction. This would seem to be as a result of fundamental differences between their perception and the relativity of the intended building. This evidence suggests that design rigidity—in domestic scale construction at least—should be approached with caution.

To summarise, this chapter aimed to shed light on the perceptions of mobile phones within construction. We found that in terms of function, which was revealed as being dominant in the existing description of construction as used by the industry to describe the process of construction, the participants are quite unified in their perception of the function of mobile phones. However, neither perceptions of tension or negotiation are unified, these being aspects to construction that were revealed within chapter four, which form additional facets to a broader description of construction. We found differing perceptions to both the tensional facet of construction and in perceptions towards the practice of negotiation. This is potentially important within our understanding of the operation of communication technology within this context. Of the three facets we have identified to communication, only function is represented in the industry's description of construction. It is also the only facet where the participants' perceptions are consistent. The additional two facets to communication—tension and negotiation—are neither included in the industry's dominant description nor are the perceptions of these facets consistent between the participants. The evidence suggests that a considerable variation of opinions exists within the industry regarding mobile phones specifically and communication technology in general. However, this variation does not seem to be acknowledged within the operational and communicative models reviewed in chapters one and two.

In the following chapter we begin the third and final strand of the research, which will document the actual usage of mobile phones during a construction project.

6. STRAND THREE: USAGE OF MOBILE PHONES DURING CONSTRUCTION

> Two-road chance is essential and absolute, with it comes the possibility of 'absolute newness'; it alone is at the source of every innovation, of all creation in the biosphere.[328]
>
> Whoever the Gods of Fortune are, they will drop things into your path, but if you search for those things you will not find them.[329]

6.1. INTRODUCTION

In this chapter we begin the third and final strand of the research. It will document the usage of mobile phones within the rich communicative context of construction. We will progress this thesis by comparing the documentation of the perceptions of mobile phones in chapter five and the usage of mobile phones within construction, which will be documented in this chapter.

This chapter will first consider some of the influential factors in considering *construction as a creative process*. To do this we draw upon works by Hyde[330] and Monod[331] that inform our understanding of construction as a creative process and help identify contributing factors for the focus of our documentation. We use the opening quotation by Monod—and the suggestion that creativity is related to chance—as a starting point for our interrogation of creativity and innovation. In the second quotation Hyde suggests we resist searchin*g* for fortune, as it will not be found. Thus, it is unlikely that creativity and innovation within design and construction will be tangibly identified in a particular role, activity or device. We follow Hyde for insight into understanding the potential for creative opportunity. We then discuss *trans-disciplinarity in construction* and reflect upon the process of translating ideas from designs to buildings. Having established influential factors in the creative process of construction we will outline the *documentation of the usage of mobile phones in construction*, clarify the aim of this strand of the research and

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[328] Monod, *Chance and Necessity* p. 120.

[329] Hyde, *Trickster Makes This World: Mischief, Myth, and Art* p. 131.

[330] Ibid.

[331] Monod, *Chance and Necessity* p. 114-30.

outline the method to achieve it. Finally we will analyse the findings within the final sections of this chapter.

We intend to document a domestic scale construction project, where an attic storage roof space is converted into an additional bedroom. The project will be documented from inception through to completion. Rather than the retrospective accounts and perceptions of participants documented in chapters six and seven we now turn our attention to the actual usage and appropriation of mobile phones during construction, their influence on participants and working practices during operational activities during construction.

6.2. CONSTRUCTION AS A CREATIVE PROCESS

In this section we seek to expose some of the influential factors that are implicated in construction as a creative process. We established in chapter one that the construction industry seems to favour a description of construction that is dominated by function. This could be the function of fabrication, assembly or communication; participants and roles within construction can also be forced into this functional paradigm. In chapters four we established that other facets such as tension and negotiation in addition to function exert influence on the construction process. Kling has studied and written widely on environments where computing technologies are introduced into the working environment and he has shown that the political tensions within the environment influence the adoption of such technologies.[332] In one example Kling illustrates how technology was implemented to enhance efficiency and was used by key personal to increase their control of sub-groups within the organisation. The technology "limited the ability of other groups to effectively alter the direction of the CBIS's (computer-based information system) development." [333] Veen[334] has also acknowledged this political aspect brought to centre stage by Kling. In a study of the deployment of content management systems (CMS) he has observed the implementation of systems being resisted by creative

[332] Kling, *Computerisation and Controversy: Value Conflicts and Social Choices.*

[333] Kling and Iacono, "The Control of Information Systems Developments after Implementation."

[334] Jeffery Veen has been involved in the redesign of a number of Content Management Systems such as Flickr and Blogger. For more on this see Veen, *Why Content Management Fails* ([cited).

sub-groups within the organisation, who claimed the restructuring affected their role adversely. Veen argues that the design of an organisational system need not necessarily negatively influence creative activities within that system. Both these scholars argue that there are additional factors beyond functionality that warrant consideration where a technology is being introduced into a complex process.

In chapter four we introduced the biologist Jacques Monod who suggests a strong link between creativity and chance.[335] He argues that the opportunity for innovative genetic mutations arise from the opportunity of a chance meeting of molecules or circumstances. Arguably the opportunity for innovation and creative opportunity arises from a chance meeting of people or circumstances. This is true in many areas of human activity, not just construction. Hyde points to opportunistic Trickster figures from various cultures being found at crossroads, a location synonymous with opportunity and chance encounters:

> In the Yoruba religion the same phenomenon is well worked out in the figure of Eshu, who dwells at the crossroads, the classical focal point of true coincidence.[336]

Various cultures associate opportunity with the crossing of roads and thresholds. Hermes, the Greek messenger was a mortal who created his own fortune through commerce between the domains of men and Gods. While the domains involved in construction are not as distant as that of Gods and men, Lawson suggests a barrier exists between the designer and builder.[337] These boundaries cause an increased remoteness between the domains; Monod's thesis suggests that where the potential for chance is limited, as in circumstances where interaction is rigorously prescribed, so too will the potential for creativity be restricted. If there is to be creative opportunity within the construction process there should exist within construction some potential for the transgression of disciplinary boundaries and chance encounters between the participants.

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[335] Monod, *Chance and Necessity* p. 114-17.

[336] Hyde, *Trickster Makes This World: Mischief, Myth, and Art* p. 119.

[337] Lawson, *How Designers Think: The Design Process Demystified* p. 24.

This section has revisited the notion of creativity in construction processes, it would seem the opportunity for creativity inherent in collaborative activities is released by the transgression of disciplinary boundaries. We have also exposed some of the factors that are potentially implicated in construction as a creative process. The suggestion is that creativity is not an easily prescribed quantitative tangible component within the construction process. Rather, for Monod and Hyde, the potential for creativity lies between prescribed components and domains. The channels between the domains of activity enabled access to disciplinary gaps and the creative potential within those gaps. We will discuss these trans-disciplinary channels for communication in the next section of the chapter.

6.3. TRANS-DISCIPLINARITY IN CONSTRUCTION

This section we focus on factors influencing trans-disciplinary communication in construction. To do this with we will briefly recap on our findings from chapter two, which reviewed the types of communication practices that have been documented by others when exploring trans-disciplinary communication in design and construction. In chapter two we found a limited amount of research had been specifically focused on the interactions between the disciplines during design and construction. Cushman was discussed in the context of knowledge sharing[338] through retrospective workshops after the completion of a construction project. Burry has been discussed in the context of collaboration during construction,[339] where technology *sponsors* communication between design and construction. In Shoal Fly By a *digitally sponsored* convergence of artist, architect, mathematician, fabricator and engineer illustrates potential benefits from the involvement of what are typically disparate disciplines. These disciplines converge at an early stage of the project while the construction process and to some extent the design process, is still fluid.

[338] For more on this see Cushman and Cornford, "Infrastructures for Construction Collaboration: The Cross Organizational Learning Approach."

[339] Burry, "Digitally Sponsored Convergence of Design Education, Research and Practice".

The trans-disciplinary collaboration explored by Burry is in marked contrast to collaborative initiatives such as *partnering*, which has been discussed at length in chapter one. Partnering is a contractual arrangement for construction that—in theory—enables closer collaboration between designer, client and contractor and is intended to produce a more efficient construction process and better public buildings. It could be argued that partnering is also a trans-disciplinary communicative model, but there is a distinct difference between the two approaches. While one sponsors an innovative design solution, the other seems to sponsor questionable build quality.[340] At an early stage during Shoal Fly By the designers are connected with mathematicians, programmers and fabricators, this is not collaboration at a management level as in partnering, but collaboration of the participants who will engage in the design and construction process. Each discipline potentially has a very different conception of the intended object to the others. Partnering on the other hand does not involve these disciplines; the collaboration is at an organisational level where communication is between designers, construction organisations, government committees etc. Partnering also adopts a linear collaborative model where—for example—a designer would sign-off on a design, passing it to a construction organisation that would modify the design to ensure it is as easily constructible as possible. This reduces the need for some collaboration. This approach to trans-disciplinary communication does not invest importance in the translation and communication of the idea and it's understanding, which can be identified in the communicative processes of Shoal Fly By.

6.3.1. Construction: Translation of Ideas

Lawson cites various examples of design and construction processes that challenges the linear design/construction process, and challenges its ubiquity as the only or most conducive model for successful design and construction.[341] In interviews with the designers Eva Jiricna and Carlo Scarpa, Lawson reveals examples where their design process begins with construction details from which

[340] There remains controversy surrounding partnering, particularly in the form of the Private Finance Initiative (PFI) and its success or failure. Some of the arguments have been expanded in chapter 2.

[341] Lawson, *How Designers Think: The Design Process Demystified* p. 212-14.

they work backwards towards a general design. Jiricna starts by finding a sympathetic juxtaposition of materials and resolving the detail of how they relate to each other. Scarpa in one extreme example starts with the actual craft of timber cutting and his design of a handrail at the Castelvecchio Museum at Verona[342] is based on the process used by the local craftsmen to cut the timber.

The partnering approach to trans-disciplinary working does not extend to this level of nuance. Rather it concentrates on an organisational collaboration, where the ideas and designs are passed from one discipline to another rather like being passed between carriages of a train. When framed like this, partnering would seem only to be a limited form of collaboration.

During Shoal Fly By the communication technology was also implicated in the translation of the design. The model was scanned into the computer and refined by modellers. The designers envisaged an elegant tubular structure so they approached tubular pipe fabricators to understand the process and limits of fabricating tubular steel. Based on the information, mathematicians' worked to revise the model with programmers to ensure the geometry of this elegant form was within the limits of fabrication. The model was then translated into a graphical description used by the fabricators that was far removed from recognisable construction documentation. In this case the graphical description was a spreadsheet of distances, angles and rotations for each strand of pipe within the design.

Arguably it is the success of the translation that contributed to the success of Shoal Fly By. The failure of this translation causes problems within the partnering structure of collaboration. While both models of collaboration involve computing technology, in Shoal Fly By the technology contributes to the convergence of many different conceptions of the object. It would be presumptive to suggest that this resulted in one unified conception of the object by all participants, but it did result in the participants being able to translate their conceptions more accurately for others. While partnering does facilitate more detail, it perhaps does not facilitate this conceptual convergence.

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[342] Ibid. p. 278-79.

6.3.2. Translation: The Negotiation of Different Conceptions

The previous section has discussed the detail and translation of design ideas, and how technology has been implicated in those processes. In their seminal text *The Mathematical Theory of Communication*, Shannon and Weaver discuss the problems that can arise when detail is lost during communication:

> Entropy is related to "missing information" inasmuch as it is related to the number of alternatives which remain possible to a physical system after all macroscopically observable information concerning it has been recorded. [343]

The quotation resonates with the example in the previous section; whereas in Shoal Fly By the design translations were reducing the number of alternatives that remained possible, in collaborative models for construction such as partnering—although the detail of information generated is greater—this does not necessarily reduce the number of design alternatives. Within the construction domain, after an idea has been exhaustively recorded in the sanctioned quantitative forms of construction documentation, there still remain many alternative translations and conceptions of that information.

Reddy suggests this problem can be attributed to the assumption that entropy can be expunged from communication by thoroughness. He proposes an alternative to the linear model of communication in the *toolmaker's paradigm*,[344] and through it contests the assumption that any idea can be accurately and completely described by one person, so that another person can accurately and completely recreate it. In fact Reddy suggests that misunderstanding should form the underlying basis of communication and concludes that an iterative cyclical exchange between participants is a more constructive model for communication, particularly where the exchange is between different cultural domains. Lawson has reached a similar conclusion regarding design and construction, although he acknowledges the benefits of certain prescribed components within the construction process, Lawson questions how those components relate to each other:

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[343] Shannon and Weaver, *The Mathematical Theory of Communication* p. 3.

[344] Reddy, "The Conduit Metaphor: A Case for Frame Conflict in Our Language About Language."

> Certainly it is reasonable to argue that for design to take place a number of things must happen. Usually there must be a brief assembled, the designer must study and understand the requirements, produce one or more solutions, test them against some explicit or implicit criteria, and communicate the design to clients and constructors. The idea, however, that these activities occur in that order, or even that they are identifiable separate events seems very questionable.[345]

In this section of the chapter we set out to look at influential factors within trans-disciplinary communication. It has revealed the nuances of collaboration are of particular importance within this form of communication. Unlike communication within a single domain or discipline, there is much greater potential for misunderstanding when communication is between disciplines or cultural domains. It would seem that where this is the case, trans-disciplinary communication is more effective when it is iterative rather than linear. We have also revealed a distinction between the influence of *detail* and *understanding* within communication. The process of partnering and the unorthodox construction process documented during Shoal Fly By both involve increasing detail through collaborations. However, partnering seems to focus on quantitative detail, which does not necessarily sponsor collective understanding. Shoal Fly By, on the other hand used technologies to enhance collaboration to sponsor a convergence of understanding. This suggests collaboration and communication through the increase of detail alone is not a prescription for effective communication.

6.4. THE DOCUMENTATION OF THE USAGE OF MOBILE PHONES IN CONSTRUCTION

This section will expand on the project that will be the source of the documentation, based on the findings from the previous sections we will explain the precise aim of this strand of the documentation and finally we will outline the method that will be used to achieve that aim.

6.4.1. Source of the Documentation

The source for this strand of documentation will be an actual domestic scale construction project. Studying a project such as this will facilitate close observation

[345] Lawson, *How Designers Think: The Design Process Demystified* p. 48.

of the processes, working practices and usage of mobile phones by the participants. Active involvement within the construction process is most desirable and will provide the greatest potential exposure to communications and working practices within the construction process. This will enable active rather than passive involvement in the process and provide a platform from which to document the construction project and facilitate first hand access to the project, the communicative relationships and the data to be gathered.

For a period of seven months between August 2005 and February 2006 the author acted as the role of architect[346] on the conversion of a roof space storage area into an additional bedroom for a family of five. Responsibilities for the role of architect began with the initial design development with the client and later involved submitting the design to the local authorities for approval. Finally the responsibilities of the role of architect ended with the design and construction being approved by the local Building Control Authority and the client returning to live in the dwelling.

Figure 6.1 House before roof space conversion

[346] In the spirit of ethnography, rather than observe the author will be part of the construction project.

Figure 6.2 Condition of roof space before conversion

6.4.2. The aim of the documentation

Previous sections of this chapter have discussed complexity within communication, by drawing on Monod and Hyde we have outlined key factors within construction—particularly the gaps that exist in communication between different disciplines—and how the chance encounters they facilitate implicate them in construction as a creative process. We have explored the nuances of trans-disciplinary communication and revealed that increasing detail did not always equate to effective communication.

The aim of this strand of the research is to document a construction project, paying particular attention to the usage of mobile phones and working practices where they are implicated in the nuances of trans-disciplinary communication within operational activities of construction.

6.4.3. Method of the documentation

One of the affordances of the mobile phone that makes it so provocative in this context is its propensity to be used instantly and impulsively. As this strand of the research is focused on documenting the usage of mobile phones, it is perhaps not appropriate to rely on retrospective methods such as interviews. Retrospective accounts are likely to miss the nuance of communication and working practice that Reddy, Hyde and Lawson have revealed to be valuable within this context. It is

preferable for this strand of the documentation that the data is collected first hand on a construction site to avoid potential gaps within the documentation.

This method is not without potential difficulties, we will discuss them and outline a strategy for limiting the effect of these problematic factors during the documentation. Passive observation can be problematic within the construction environment as access to construction sites may be limited due to health and safety policy. The necessary requirements for induction onto a construction site many be impossible or at least impractical. Access to communication and documentation during the construction process can also be restricted because of confidentiality and the legal implications of disclosing potentially sensitive information. In terms of this thesis, the main concern regarding documentation is the impulsive and ad-hoc nature of mobile phones, which would be difficult to record through passive monitoring. To mitigate these factors the author will actively participate rather than passively observe a construction project and document the working practices and mobile phone usage during the execution of the domestic scale construction project that was described at the beginning of section 6.4.

The case study for this project can be found in Appendix A.3, it was created from a variety of data sources maintained during the construction process which were documented as part of a weekly written log that included phone calls, SMS text messages, meeting with clients, consultants and local authorities. Drawings were the primary means of documentation and communication; the drawings and their evolution can be found in Appendix A.4. Letters and e-mails were used to communicate occasionally with the client and predominantly with other consultants, such as the structural engineer, and local authorities. The correspondence can be found in Appendix A.5.

As the construction project progressed it became apparent that SMS text messages were being frequently employed by the contractor as a means to communicate, as such the freely available software BluePhoneElite[347] was used to

[347] *Bluephoneelite*, (Mira Software, [cited 26.06.05]); available from http://mirasoftware.com/BPE2/.

back up SMS messages located on my mobile phone onto a computer. The usage of this software is documented further in Appendix A.3.

6.5. ANALYSIS OF THE USAGE OF MOBILE PHONES DURING CONSTRUCTION

In the following sections we will document our findings before summarising them under the themes of *function, tension* and *negotiation*. The construction project lasted approximately seven months, which resulted in a substantial amount of documentation, including drawings, e-mails, letters and a log of phone calls and meetings. Specific elements within the process—much like Lawson[348] and Evans[349] imply—are difficult to isolate from contextual factors and the influence of other aspects of construction. This section will recount three key instances, which will serve as vehicles for exploring the communication practices and the use of mobile phones within the construction process. They will be referred to as the *fire escape, structural* and *staircase* examples; they are briefly outlined below. So that these examples can be understood for the purpose of the thesis they have been untangled from the overall process and specific sections of the case study found in Appendix A.3 are dedicated to each individual instance.

6.5.1. The Fire Escape Example

This example revolves around a legal requirement within the design to provide a means for escape in the newly converted roof space bedroom in the event of a fire. Fire escape windows are highly prescribed, the Building Regulations specify size and critical dimensions for ease of escape by occupants and access by fire services. A drawing was issued to the building contractor[350] that included all the critical dimensions and the window specification necessary to fulfil the building regulation requirements. However, the existing roof structure prevented the

[348] We have periodically drawn upon Lawson and his assertion that it is difficult to isolate the individual stages of the construction process, as they usually overlap. For more on this see Lawson, *How Designers Think: The Design Process Demystified* p. 48.

[349] Evans' uses the phrase "constellation of practices" repeatedly when referring to design and construction. Suggesting a complexity in the inter-relationships of working practices. For more on this see Evans, *Translations from Drawing to Building and Other Essays.*

[350] Appendix A.4, drawing AA-02

contractor achieving the exact critical dimension, he was required to make an impromptu valued judgement concerning the position. The window was installed in a position beyond several critical dimensions as specified within the building regulations. The contractor was dissatisfied with the fire escape window drawing, as the window could not be installed within the existing roof structure as drawn. This proved problematic as the changes took place without the architects' knowledge and a delay was caused while the window position was negotiated with the local authorities.

What are of interest to us in this example are the differing levels of value that were placed on different elements of the window by different participants within this situation. Within the architect's conception of the situation the drawing had a high value, it was *sacred* so to speak and it was the architect's primary mode of communication. When it became apparent the window could not be constructed in the location specified in the drawing, its value—within the conception of the contractor—dropped substantially, who then resorted to their own value framework regarding the window and where it should be positioned. This difference between the individual value frameworks of participating groups within construction is a theme that reappears throughout the construction project and our selected examples.

In the fire escape example mobile phones were not used to circumvent official communication channels, compensate for poor planning or to avoid the official documentation of decision. This challenges the predominant perception of mobile phone usage that was documented in chapters five. Mobile phones were appropriated during this construction project because they were an effective means of making contact. It was used in one instance because the official channels for communication with the local authority were slow and other aspects of the construction work were being delayed as the contractor awaited a verdict from the local authority. When the decision was made the architect was contacted immediately via mobile phone, and then contacted the contractor so that the impact of the delay could be minimised as much as possible. Ultimately, to resolve this situation the position of the fire escape window required modification and mobile phones were implicated in negotiating the critical dimensions that had to change so

that the local authority, architect and contractor could agree on a solution that satisfied all participants.

Figure 6.3 Fire escape window in-situ

6.5.2. Structural Example

In this example the building control division of the local authorities, stipulated that the existing roof space floor would require reinforcing to support any additional loading as a result of its change of use from a storage space into a bedroom. An engineer was appointed who submitted a structural design for reinforcing the roof space floor to the building control division of the local authority. This was quickly approved and allowed the structural changes to be implemented by the contractor on site. However, it transpired as the structural reinforcing work commenced that the engineering solution could not be achieved due to the unique way that the existing roof space floor was constructed. Construction work had to be stopped until the situation was resolved. After several phone calls between the engineer, architect and contractor it became apparent that a solution would not be arrived at through phone calls alone and a site meeting was called.

In this instance we again find different value frameworks. When the contractor attempted to implement the structural drawing, it became apparent that it was not possible, in fact the structural drawing appeared to be a generic solution that in no way addressed any of the site conditions unique to this house. This caused the contractor to again become frustrated and caused another delay. The value of this drawing was initially very high, having been specifically requested (and approved) by the local authority and work was only able to progress upon its approval. Many aspects of the construction were reliant on the completion of the floor reinforcing. When the structural drawing arrived, rather than progress being expedited it was impeded when the contractor realised the drawing had almost no value in terms of construction. Again we have something—in this case a structural drawing—that is highly valued within the organisational and administrative value framework of the construction project but which proves to have little value within the operational on-site value framework.

It is also worthy of noting that the structural solution that was eventually arrived at and constructed had been proposed earlier by the contractor and originally dismissed by the structural engineer. This was also a cause of some tension, after the highly ritualised tendering for the work, appointing an engineer, submitting to the authorities, their subsequent approval and eventual delivery of the single drawing, the high value attached to it seemed misplaced as it was ineffectual.

In this example mobile phones were implicated in the quick identification of a compatibility problem between the structural drawing and the actual site condition. Although it was not directly involved in the negotiation in which the parties arrived at a solution, it was indirectly involved. Through the usage of the mobile phone it quickly became apparent to the participants in this example that the issue would not be resolved without a direct meeting on the construction site.

6.5.3. Staircase Example

Whereas the previous two examples are somewhat similar in that they document inconsistencies between the documentation and the site condition, this example proved different. It is of interest again because of the different value

frameworks, which have been emerging from the findings from this strand of the research.

The contractor and client made a joint decision—contrary to architectural advice—to remove the staircase sub-contract from the construction program, a direct saving of £1800. The contractor would purchase a standard *Screwfix*[351] staircase and—to quote the client—with some *giggery-pokery*[352] modify it to fit. From an architectural perspective a Screwfix staircase was not recommended because of the restricted space available for the staircase and the intricate design necessary to conform to regulations.[353] It was felt it would be in the best interests of the smooth running of the project to sub-contract it to a specialist.

It emerged that the contractor lacked the specialist knowledge required to modify the Screwfix staircase and they were unable to make any independent progress on it. This element of the construction continued to be pushed back within the construction programme. Eventually the contractor had to install the staircase and after a consultation between the architect and the local authorities regarding the specifics of the staircase, the contractor and architect met on site with documentation specifying the regulatory information for staircases.

[351] Screwfix is a trade name, which provides 'off the shelf' products. In this case they have a selection of standard staircases that can be ordered. As with off the shelf products they provided limited variety.

[352] This terminology, although a colloquialism, has its origins in *joukery*, a Scots English phrase for "underhanded dealing, trickery," and *pawky* from the Scots Irish meaning "artful." This is perhaps an apt description of what transpired and has relevance to artistry within the context of this thesis. Both etymological sources from the Oxford English Dictionary Online.

[353] For the stair design see Appendix A.4, drawings AL/BC-08 and AL/BC-09.

Figure 6.4 Staircase opening, as it remained until the architect intervened

What is of interest within the context of this research is that a solution was arrived at surprisingly quickly without the tension and friction that dominated the previous two examples. In this example it would seem—superficially at least—where the parties had least knowledge and the most fluid value framework the negotiations resolved the situation with the least conflict and tension.

In this example mobile phones were again not directly implicated in the problem resolution. However, the lack of progress combined with the regular requests for further information that was being received regularly by the architect via mobile phone was suggestive of an emergent problem.

6.6. FUNCTION

While the qualities of *Firmitas, Utilitas* and *Venustas* have been bestowed sacred status by Vitruvius and Henry Wootton in the assessment of architectural product,[354] perhaps *function, negotiation* and *tension* are a trinity of qualities for architectural processes. In this section we analyse how mobile phones functioned alongside other communication technologies during the process of construction. We aim to understand the complexity of the mobile phone's usage within the construction process.

In the construction project the mobile phone was the only communication device on the construction site for contacting the contractor. In this respect it was not used out of opportunity and convenience, as well being effective it was—in this instance—the only means of communication with the contractor. The participants were using a small fraction of the functionality that was present on the mobile phone. However, there was considerable complexity to the situations in which mobile phones were used and how they were used. Calls from the contractor to confirm specifications were usually followed up with a SMS message:

> When confirming the specification with the contractor, which was usually over the phone, this verbal information would be confirmed with a follow-up SMS text message so as to remove any ambiguity surrounding reference numbers and specifications.[355]

Discussing mobile phones only in terms of function is inadequate to address the operational influence of mobile phones on working practice. Mobile phones exerted influence on the construction process beyond the perceived concerns of health and safety risks[356] or as substitute for poor planning. In the fire escape

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[354] For a more detailed critique of Vitruvius, Wootton and firmness (firmitas), commodity (utilitas) and delight (venustas), see Sebastian MacMillan, *Designing Better Buildings* (London: Taylor and Francis, 2004).

[355] Appendix A.3, section 15.7.1.

[356] As yet the evidence for the Health and Safety argument of mobile phones causing accidents during construction is at best inconclusive. Statistics gathered by Haslam et al. regarding the cause of accidents in the construction industry does not refer to mobile phones. However a report in Buildingtalk suggests the Health and Safety Executive do acknowledge that mobile phones might be implicated in falls from small heights. For more on this see Haslam et al., "Contributing Factors in

window example[357] that was discussed in the previous chapter we see mobile phones implicated in how the participants arrived at a solution to resolve the window design, construction and regulatory requirements. Although it was the architect who first noticed the position of the window did not comply with regulations, there were many communications that used mobile phones between all the involved participants before it was resolved. We also see mobile phones implicated in the practice of negotiation, where participants discover inconsistencies on the construction site or in the documentation and need to negotiate and converge on a solution that allows the project to progress. As illustrated in the structural example,[358] during construction it was the contractor who identified these inconsistencies and subsequently began the resolution process by contacting the architect. Where we found the functionality of mobile phones being invoked during construction, it was to deal with gaps between components or gaps within knowledge. This resonates with the theme of privatisation that emerged during the first strand of research. In this example the mobile phone is invoked to mitigate against the privatisation caused by the remoteness of the site and contractor from other participants, thus enhancing collaboration and expediting arrival at a solution.

The evidence reinforces our emerging proposition that a purely functional framing of construction does not adequately reflect these nuances of communication during the construction process or the influence of mobile phones on that process. To grasp an appreciation of this complexity we will draw upon other aspects of construction that emerged from chapter four through the alternative description of construction when it is considered as a creative process. In the following sections we address the aspects of *tension* and *negotiation* during construction and the influence that these facets of mobile phone usage had on the construction process.

Construction Accidents." Also Buildingtalk, *Mobile Phone Culture Puts Tradesmens Lives at Risk* ([cited).

[357] See Appendix A.3, section 15.17.

[358] See Appendix A.3, section 15.18.

6.7. TENSIONS: THE SACRED AND PROFANE

In this section we will turn our attention to the tensions that emerged during the construction project. We have framed these in terms of the *sacred* and the *profane* values that were revealed during the project. Conceptions of the sacred and the profane have strong associations with religion and according to Durkheim[359] they are often incorrectly aligned with good and evil. Sacred[360] comes from the Latin to *restrict, enclose, protect*. Profane[361] comes from the Latin meaning *before the temple*. Three things are implied in their etymology, firstly a religious underpinning, secondly protection is equated with the sacred and thirdly it distinguishes the profane as something excluded from the protection bestowed on the sacred. The sacred and profane are not explicitly aligned with religious notions of good and evil. Durkheim claims there can be sacred good and sacred evil and profane can be either as well. We will periodically draw upon Durkheim in this chapter to explore the complexity of this relationship and how it is implicated in the observed working practices of construction.

The relationship between the sacred and profane is not one of harmony, but it is one of tension. Culturally there is often much invested in distinguishing them, distance according to Douglas plays an important role in ordering the sacred and profane:

> Ideas about separating, purifying, demarcating and punishing transgressions have as their main function to impose system on an inherently untidy experience. It is only by exaggerating distance... that a semblance of order is created. [362]

Distance between the sacred and profane can be created by physical boundaries such as walls, or it can also exist in terms of ritual. Transition from the

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[359] For more on this see E. Durkheim, *The Elementary Forms of the Religious Life*, trans. Joseph Ward Swain (London: George Allen & Unwin Ltd., 1954) p. 37.

[360] Sacred from the Latin "restrict, enclose and protect." Although it does have strong religious connotations, which can be assumed by association, here we consider its Latin source as something protected and of value.

[361] Profane from the Latin "out in front of the temple." It is that which is not sacred, thus the ordinary rather than the popular conception that profane is bad or negative.

[362] Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* p. 4.

sacred to the profane and vice versa—according to Durkheim and Pirsig—can be by way of lengthy ritual. This again serves to place an emphasis on the difference between the sacred and profane and justifies the value bestowed upon the sacred. Fish who has written extensively on law, addresses a similar notion in relation to authority, a theme that has currency within our discussion of the sacred and profane within construction:

> The rule of law - of perfectly explicit and impersonal utterances - is replaced by the rule of persuasion, the rule of "the litigant having at the time being the greater power of persuading the trier of fact." As a result, authority becomes structurally unstable, embodied not in some abiding core (what H. L. A. Hart calls an "authoritative mark") but in the words of whatever person or persons happens to have sway "at the time of being." This last phrase connects the court's fear with an ancient tension between a notion of truth as something independent of local, partial perspectives and the notion of truth as whatever seems perspicuous and obvious to those embedded in some local, partial perspective.[363]

The superiority of authority is related to its ability remain distant from change, and according to Fish, authority is undermined the more it changes or is challenged. The transition between the sacred and profane is negotiated through rituals that are typically long, complex and highly specified. Both Hyde and Pirsig individually explore Native American culture and ritual. Pirsig documents long ceremonies where participants transition from ordinary consciousness to a higher sacred state of consciousness through lengthy rituals. This facilitates the shift from the profane (ordinary) to the sacred, thus we find temporal distance also implicated in the sacred and profane transition:

> Sometime after midnight, after he had listened to the singing and beating on the drum for hours and hours, something began to change. The exotic aspects began to fade. Instead of being an onlooker, feeling greater and greater distance from all this, his perceptions began to go in the opposite direction. [364]

Built into this process of transition from profane to sacred is the potential for incremental change, albeit as Pirsig suggests very slowly. However, the periodic

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[363] Stanley Fish, *Doing What Comes Naturally: Change, Rhetoric, and the Practice Of, Post-Contemporary Interventions* (Durham, NC: Duke University Press, 1989) p. 5.

[364] Pirsig, *Lila: An Inquiry into Morals* p. 38-40.

transition of the ordinary into the sacred affords slow change that does not undermine the sacred and its authority in the way Fish claims frequent change can. It also enables the sacred to respond to evolving social or political conditions.

Now that Durkheim, Hyde and Pirsig have informed us as to the nature of the sacred and profane, let us return to the fire escape example[365] and re-examine it through this lens. We see that those invested in orientation of the construction project—such as the architect and local authorities—place a high value on the fire escape drawings and the regulations that were embodied within them. The local authorities considered the regulations as sacred and the architect considered the drawings as sacred. The fire escape window drawing—part of which is illustrated in Figure 6.5—was passed to the contractor and it became apparent to the contractor that the window could not be installed as drawn because of the existing roof structure, as illustrated in Figure 6.6. In the eyes of the contractor the drawing seemed to lose much if not all of its sacred value[366] in the context of the construction site. The contractor proceeded and installed the window as illustrated in Figure 6.7 as they would in any other similar circumstance. It was installed further up the roof to facilitate better views from the room. It should be noted from Figure 6.5, Figure 6.6 and Figure 6.7 that the window could have been installed much closer to the location as prescribed on the drawing.

[365] Appendix A.3, section 15.16.

[366] When this matter was being discussed on site with the architect and the contractor present the drawing was visibly distressed and crumpled.

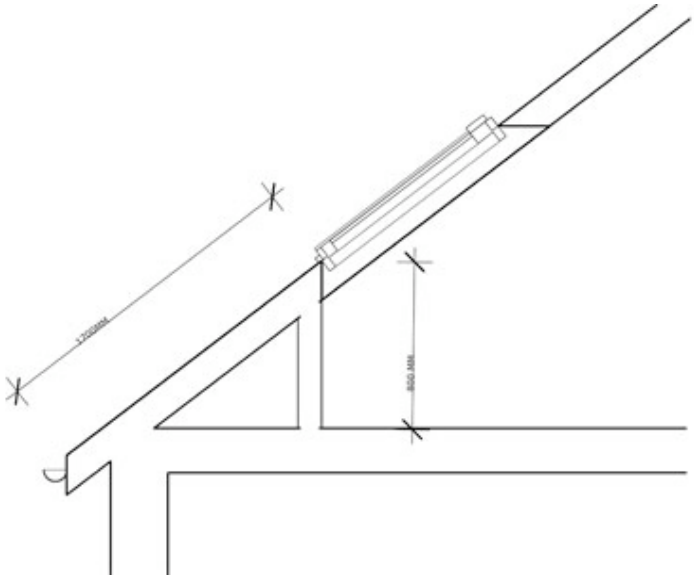

Figure 6.5 Fire escape window drawing

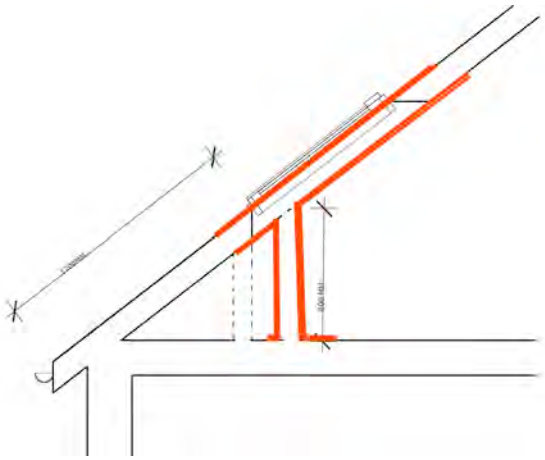

Figure 6.6 Actual roof structure preventing window installation

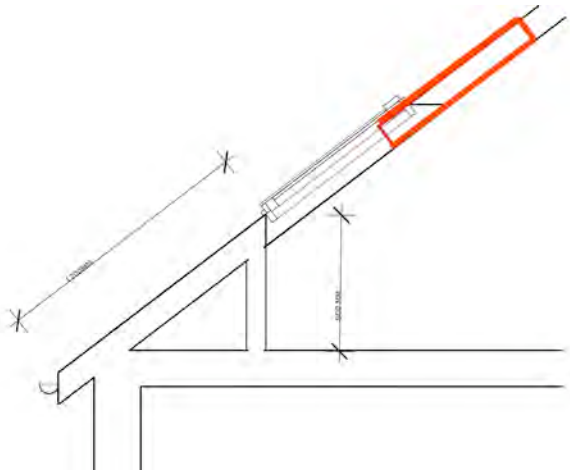

Figure 6.7 Position of window as installed by contractor

Within the context of the construction site the existing roof structure and the views from the window seemed more *sacred* to the contractor than the drawing or the regulations. The window was installed in a location that the contractor perceived would provide the best views and the most light. This did not resonate with the local authority's perception of the sacred, which was the window as a means of escape. Returning to our theme of privatisation, in this example we observed participants individual conception of the window remain private. No channels for cross communication were opened, which would have identified and possibly resolved the difference in individual perceptions.

The absence on any acknowledgement by the contractor of the drawing and the critical dimensions that were outlined within it caused some tension between the contractor and the architect when they met on site to discuss the window.[367] The contractor valued as sacred the aspects of the window component that facilitated light and views. The architect valued as sacred the aspects of the window that enabled it to fulfil the regulations. The tension between these two value frameworks remained unresolved until a consultation with a building control officer resulted in a *relaxation* of the regulations to accommodate a compromise. When the officer considered the specific circumstances and function of the additional room,[368] it was deemed that the window did not have to fulfil all the regulations. However, it should be closer to the regulatory position without having to modify the roof structure. This *ritual* of negotiation of the sacred and profane in these circumstances maintains the authority of the building control regulations while accommodating change. It also avoids a resolution in terms of *right* and *wrong*, which might undermine a particular value framework and thus undermine the authority of the participant who holds that value framework.[369]

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[367] It also caused visible distress to the client who left during the meeting clearly upset.

[368] As the new bedroom would be the master bedroom, it was deemed that children would be unlikely to access this room and thus it did not have to be as close to the floor as the regulations stipulated. This need to achieve this critical dimension was relaxed.

[369] Suffice to say, argumentation and collaboration are particularly important in a group activity such as construction. For a more detailed analysis of the anatomy of argumentation see Tweed, "Supporting Argumentation Practices in Urban Planning and Design."

6.7.1. Sacred

Let us turn our attention to the sacred within design and construction. The Ten Books of Architecture by Vitruvius are arguably the original architectural manuals. In it Vitruvius documents what is considered sacred criteria for successful design and construction as it addresses "all the principles of the art"[370] of architecture. McEwen who has critiqued Vitruvius and The Ten Books, points out that accurately obeying these principles is not always sufficient. Through this we are prompted to consider that the sacred may be insufficient and McEwen brings the notion of *tempering* to centre stage:

> It is not enough for Vitruvius that the bodies of temples be symmetrical and therefore coherent, like the body of the man who is their model. They must also appear to be so… the utterly convincing, visible coherence of form that an architect must strive for by adjusting or "tempering" proportions. [371]

Vitruvius elaborates no further on these adjustments or the intricacies of tempering this gap between the ideal principles and how they might be executed. There is merely the acknowledgement that it may be necessary to do so.

Returning to contemporary construction, these adjustments are not prescribed within the construction process. How and when to *temper* regulations or *adjust* a drawn dimension is no clearer in contemporary construction than it was when Vitruvius wrote the Ten Books of Architecture. Within the documented construction project this tempering was typically tense and contentious. Looking at the fire escape, staircase and structural examples we can illustrate how the sacred and the profane clashed. Illustrated in Table 6.1 are the different notions of sacred as observed in the fire escape example. What one domain considers sacred is not necessarily considered the same by another. The regulatory aspect of the window is not sacred to the contractor, thus they are not protecting it. The window position was innocently changed to maximise light and views, which are sacred within the contractor's value framework of the window. These innocent infractions into other participants' notions of sacred caused tensions during construction.

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[370] Vitruvius Pollio, *Vitruvius the Ten Books of Architecture* p. 4.

[371] McEwen, *Vitruvius: Writing the Body of Architecture* p. 198.

Value Framework	Contractor's	Building Control's	Architect's	Client's
Sacred Values	Views and Light	Fire Escape Regulations	Drawing	Harmony

Table 6.1 Fire Escape Window: Sacred value frameworks of different domains

The architect is predominantly based off-site and holds certain objects—such as drawings and schedules—sacred. It is not unexpected that the contractor who is predominantly based on-site—in what we consider a different cultural domain—might hold different objects or values sacred. Our documentation of the construction project suggests that different cultural domains that exist within construction are more likely to hold different value frameworks than they are to hold similar ones.

In the fire escape window example the roof structure was sacred to those engaged in on-site operations and the modification of the roof structure was not even considered. While it was generally acknowledged that a window was required in these circumstances, there was a subtle difference between the understandings held by the different cultural domains of the architect, contractor and authorities regarding this window. To the contractor engaged in site operations the window provided light and views, those were the factors cited by the contractor in his reasoning for installing the window in that particular position. However, to the architect and the local authorities that are implicated within the administration domain of the construction process the window had to comply with regulations to facilitate escape in the event of a fire. Different aspects of this single component were considered sacred within the different cultural domains.

We will return to Durkheim for a moment, which argues that the sacred can also be transferred by proximity and contact. This has currency within the staircase example[372] of the documented project. Where we have observed the contractor attempt to execute a drawing, when that drawing proved to be impossible to execute it lost its sacred value. Conversely we have observed that abstract site markings can take on sacred status if someone of authority makes them, this was also observed in the staircase example. Very little on-site progress was being made in regards to the

[372] Appendix A.3, section 15.17.

staircase, even with the conveyance of various drawings—as illustrated in Figure 6.9—to the contractor. Eventually the area for the staircase was marked and laid out as illustrated in Figure 6.8 with the help of the architect, these markings and the location were not defaced or obscured until the staircase was finished. Within the context of the construction site we could say that the contractor treated the area and the markings as sacred.

Figure 6.8 Sacred staircase markings on the construction site

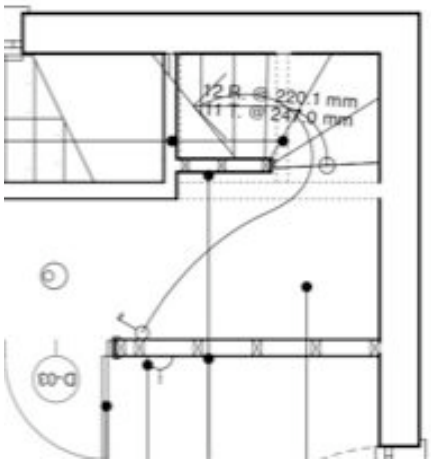

Figure 6.9 Sacred staircase drawing, not as sacred on the construction site

On the construction site this location and the markings made by someone of authority were considered more sacred than the drawings, which the same authority—the architect—had drawn. Direct contact seems to be given more value

within on-site operational culture than objects such as drawings, which are given a higher value within the off-site culture. The value of direct contact is implicated in the use of mobile phones. They have been observed in the documented construction project to facilitate direct contact with authoritative participants. This minimises delay and contributed to the smooth running of the project. However, unlike traditional paper-based official communication, contact via mobile phone leaves little or no trace of the source of instruction, making it difficult to ascertain their authority; whether they are sacred or profane. This again draws our attention to the notion of privatisation regarding communication and the effects of different cultural understandings within construction. The direct contact facilitated by a mobile phone would seem have higher or sacred value within the culture of on-site construction. Within this context privatised communication carries a distinct sacred/profane asymmetry between the on and off-site domains.

6.7.2. Profane

As we have already mentioned, profane as its Latin etymology suggests is anything that has not been protected within the sacred. It is the ordinary *before the temple*, neutral rather than negative. Categorising something as sacred or otherwise requires containment and a framework or ritual for establishing and enforcing it. The profane category is only problematic if there is the risk of unsanctioned contact with the sacred. The sacred is more associated with unity according to Durkheim;[373] harmony and order according to Jones;[374] and authority according to Bakhtin.[375] Each author in their own way deploying repetition, fixed frameworks or rituals to define the sacred. The profane is thus defined by what the sacred precludes and based on the evidence presented in this thesis, it would seem to be *fluidity*.

Returning to the documented construction project, the off-site domains of construction value *harmony* as sacred, and any object that might contribute to it, such

[373] Durkheim also suggests this is sometimes against free will, for more on this see Durkheim, *The Elementary Forms of the Religious Life* p. 206-07.

[374] For more on this see Jones, *The Hermeneutics of Sacred Architecture: Experience, Interpretation, Comparison* p. 30.

[375] For more on this see Bakhtin, *Rabelais and His World* p. x.

as drawings, regulations or schedules. This too would seem to imply that fluidity is profane and not included within this sacred categorisation. Yet in the writing of Vitruvius—as we have discussed in the previous section—we see a certain amount of improvisation and fluidity is implied when trying to reach Vitruvian ideals. It did not warrant the explanation and detail Vitruvius lavished on sacred proportions, symmetry, harmonics etc. Vitruvius invokes *tempering* where necessary to approximate these ideals when it is not possible to achieve them. According to McEwen tempering is briskly although continually referred to within the Ten Books of Architecture, implying it is an ordinary (profane) activity implicit within design and construction.

In the fire escape and structural examples documented,[376] *tempering* was—we might argue—implied in the nature of the drawings issued by the architect. Drawings as we discussed in chapter two are abstracted and generalised, the fire escape window drawing[377] referred to maximum and minimum dimensions, providing some fluidity so the contractor could find the best position to accommodate the sacred regulations but also accommodate their sacred views and light. The situation became problematic when the contractor took the regulation information in the drawing as profane and did not attempt to accommodate it. In a similar situation during the structural example the engineer furnished the contractor with a generic non-specific drawing, this implies the contractor must improvise to some extent. However, given the specific site circumstances it was not possible for the contractor to improvise within the range of what was documented in the drawing.

Value Framework	Contractor's	Authority's	Architect's	Client's
Profane Values	Improvisation	Improvisation	Improvisation	Improvisation

Table 6.2 Fire Escape Window: What the site/administration domains considered to be profane

As Table 6.2 illustrates, fluidity in the form of improvisation has been observed within the different cultural domains of the construction process. It would seem to be a normal activity within both the on-site and off-site domains, but the off-

[376] Appendix A.3, section 15.16 and 15.17.

[377] Appendix A.4, section 16.2, drawing AA-02.

site domains of the architect and local authority display a more clandestine engagement with improvisation. Participants in the on-site construction domains seem to have a more open engagement with the concept of fluidity within their working practices.

Returning to our examples, in the fire escape window example we observed the tempering of dimensions as specified in the window drawing. Due to the specific site circumstances the drawn information considered profane by the contractor was actually considered sacred by the architect and the local authority. From the contractor's perspective the aspects of the window that were valued as sacred were light and views. However, these were of little interest to the local authorities. In the staircase example we see another instance where the architect and contractor together tempered the staircase resulting in a solution that wasn't the ideal solution for either participant. The contractor and client wanted to construct the staircase as economically as possible without the winding triangular shaped *kite* steps[378] as illustrated in Figure 6.9 Sacred staircase drawing, which was proving problematic. The architect wanted the staircase constructed as ergonomically as possible as in the original design illustrated in Figure 6.10. The negotiation in this instance seemed to avoid the tension and heated discussion that was observed in both the structural and fire escape window example.

[378] These are the non-rectangular steps that turn at the corner of the staircase. Again they are highly prescribed within the regulations.

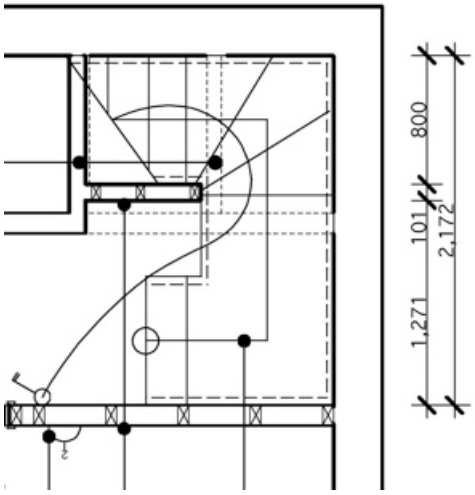

Figure 6.10 Original proposed staircase that was not constructed

Unlike the fire escape example, the improvisation during the staircase construction was not as problematic and did not generate as much tension between participants. Surprisingly this would seem to be partially because of the lack of understanding—or value framework—regarding the staircase and its regulations on the part of the contractor. While this did cause frustration for the architect and contractor it prevented the contractor improvising based on a separate sacred/profane value framework, which would probably—as in the other examples—be distinct from the architects and thus result in a different solution and consequently more tension. Both architect and contractor came together to resolve this example and neither the contractor nor architect seemed to infringe substantially on the others sacred values while doing so. This perhaps has given an insight into the value of the profane within negotiation during operational activities during construction.

6.7.3. Client Values

In chapters one and two we were momentarily drawn to industry's concern for client values within design and construction. As this thesis has progressed we have observed systemisation take centre stage in attempts to increase the productivity of the industry and consequently client values have been marginalised. This could be attributed to clients being located outside the culture of design and construction. Which may be a direct result of a lacking in familiarity with construction's specialist drawings, procedures, regulations and language. This makes it particularly

problematic for clients to participate in the abstract pre-construction processes of design in a meaningful way.

However, the second strand of research revealed clients are able to relate more significantly to the process of construction. Sub-contractors exposed how clients can exert considerable influence on the building process. In this strand of research the participation of the client also increased during the construction process. Their uncertainty with the spaces being created only emerged as the contractor was creating them and the client raised the possibly of removing rooms, moving walls and changing the staircase. This continues to add support to the argument that construction is at least partially fluid. Although change undoubtedly occurs as a result of the unforeseen and unplanned, it is also a consequence of client intervention. While systemisation can perhaps contribute to mitigating against the unforeseen, it may also marginalise this client participation and potentially client satisfaction.

6.8. NEGOTIATION

In this section we will look at the practice of negotiation during the documented construction project. We wish to see if negotiation and fluidity are problematic during construction, is expunging warranted and are mobile phones implicated in this practice?

Within the three examples[379] we used to illustrate our observations we have seen a variety of communication media used—including drawings, sketches and letters—for communication between participants. These are some of the communicative tools employed along with mobile phones by participants to negotiate their different value frameworks regarding the sacred and profane, which facilitates the continued progress of the construction project.

[379] The fire escape, structural and staircase examples, all documented in Appendix A.3.

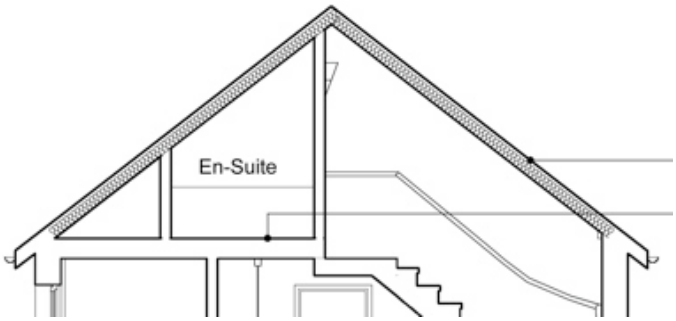

Figure 6.11 Insulation proposed by architect

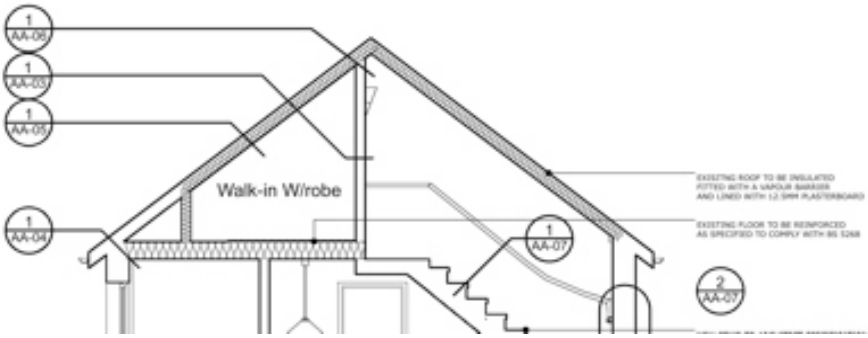

Figure 6.12 Insulation installed after negotiation with contractor

Early in the construction project we see an instance of effective negotiation, where the contractor and architect negotiate the arrangement of roof space insulation. Figure 6.11 shows how the architect proposed to insulate the roof space and Figure 6.12 illustrates the insulation after negotiation with the contractor. This subtle change meant the contractor could use more cost effective types of insulation for the horizontal, vertical and sloped surfaces. This resulted in a more cost effective solution for the client.[380] This negotiation only took several minutes and was conducted via mobile phone.

There are attempts to enforce rigorous organisational and administration procedures before construction, such as some of the current research documented in

[380] In this instance the horizontal, vertical and inclined surfaces—for Building Control approval—required different U-values and different types of insulation, the insulation necessary for the inclined surface being the most expensive. The architect had used this type throughout, however when the contractor raised this and it was discussed, a more cost effective solution yet equally compliant with the regulations was found.

chapter two. This example supports the claim that creating rigid process sequences[381] or clearer auditing processes[382] may also potentially limit similar cost saving opportunities as well as creative potential that is inherent in the process of negotiation during construction. Limiting and heavily prescribing the opportunity for contact between skilled and knowledgeable trades in this instance would have precluded the opportunity for the cost saving we observed. It would seem from our documentation that the transition of much of the design from drawing into reality occurred smoothly. However, we have elaborated in the previous section on the examples, where the transition was not smooth. In these instances we observed that the different cultural domains involved had different value frameworks of the situation. The architect, contractor and local authority attributed different values to different aspects of the situation. Rather than these different domain values being a locus of newness and creativity as Monod or Bakhtin would argue, they became the seed of contention. Tension developed in situations where a common understanding was assumed. This communication is similar to what Reddy calls the *conduit metaphor,*[383] this is a framework that considers communication as a conduit, where meaning can be contained in an agreed syntactical structure and transferred to another location and the precise meaning that existed at the source can be reconstructed at the point of reception. Reddy contests the use of this model of communication, particularly where communication is between domains that may have different cultural values.

While there is the argument that the linear conduit metaphor[384] is an efficient communication model, Reddy argues that where communication is between domains of cultural difference the conduit metaphor breaks down. He suggests an alternative in the form of the *toolmaker's paradigm.* In this model, communications between

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[381] For more on this see COMIT, *Site Design Problem Resolution* (COMIT, 2004 [cited 05/06/2005]); available from http://www.comitproject.org.uk/downloads/processMaps/narratives/p7.pdf.

[382] For more on this see Roy, Low, and Waller, "Documentation, Standardization and Improvement of Construction Process in House Building."

[383] For more on this see Reddy, "The Conduit Metaphor: A Case for Frame Conflict in Our Language About Language."

[384] As the name suggests, the conduit metaphor implies communication streams in a sequential or linear fashion.

two culturally different parties takes the form of repetitive iterative exchange and through this exchange the parties converge on a collective understanding. We observed in the documented staircase example that linear communication was initially ineffective, as the architect transferred drawing after drawing to the contractor. In the latter stages of this example non-linear communication and negotiation—in the form of the site meeting and discussions—proved more efficient than trying to limit negotiation by the linear provision of clear[385] documentation. Our findings suggest that communication during on-site operational activities although assumed as linear and similar to the conduit metaphor, is in fact analogous to the toolmaker's paradigm.

6.8.1. Resolution of sacred and profane

The documentation of the construction project illustrates that mobile phones are one of many modes of communication—sanctioned or otherwise—which the participants of a construction project appropriate to communicate. Within the construction project mobile phones have been woven into the participants' working practices and were used in conjunction with meetings and drawings to negotiate problematic situations, both SMS text messaging and direct phone calls proved to be influential within the construction process.

Figure 6.13 SMS text message from architect to contractor of window and door specification

[385] It should be noted that the documentation is often clear within the cultural domain that creates it and not necessarily clear to the domain that receives it.

As illustrated in Figure 6.13, during the fire escape example[386] mobile phones were employed early on as a way to convey specifications to the contractor. However, when information was not as clearly quantitative as in Figure 6.13, for example when abstracted drawings where used, interpretation of that information could be problematic if situations arose due to assumptions made by participants regarding the interpretation of information that had been passed between them.

Returning to the fire escape window example, although mobile phones were implicated in the quick conveyance of information to assist with decision-making, the resolution of this situation occurred through on-site meetings. In this instance a decision was made in a meeting at the building control local government office at 8:30am. The architect was informed immediately via mobile phone at a time it would not have been possible to access a landline. The architect was then able to immediately contact the contractor via mobile phone. In this example communication via mobile phone reduced any potential delays by facilitating direct and immediate contact. Of course while this information was conveyed by mobile phone it was also being conveyed officially. Several days' later official documentation arrived in the post confirming the decision that had been made by building control.

During the structural example[387] the contractor to make the architect aware of a discrepancy between the engineer's proposed structural solution and the site conditions initially used mobile phones. It becomes apparent after several phone calls between the contractor, engineer and architect that the situation would not be resolved through phone calls and the participants agreed that a site visit was necessary to resolve the issue, later during the site visit the situation is resolved relatively quickly. The use of mobile phones drew attention to a problem area, and indirectly reduced any possible delays.

[386] Appendix A.3, section 15.16.

[387] Appendix A.3, section 3.18.

We briefly mentioned in the previous section that the staircase example[388] was markedly different to the fire escape window and structural examples. The negotiation of the staircase situation was remarkably harmonious, contrary to the other instances. Mobile phones were not directly involved within the negotiation of the specifics of the staircase construction. However, much like the structural example mobile phones were one of the communicative tools being used throughout the situation as it developed. We see it implicated as one of the many communication tools to assist with negotiation between the participants to converge on an understanding. Either by removing all doubt, as in the fire escape window examples where SMS text was initially used to convey critical precise specifications regarding the make and model of the window, or as it was used later to reduce potential delay by accelerating the flow of information. In the staircase example perhaps the lack of progress on-site was a signifier of a problematic situation, given the amount of negotiation that it was generating.

Negotiation is limited by the contractual structures that exist within construction. As we discussed in chapter two, authority has been orchestrated to reside in the professional disciplines and domains. The participants engaged in construction enter into a contractual arrangement to construct whatever the design professionals have predefined. Contractually one domain would seem to serve the other and this subservience can adversely influence negotiation. These negotiations become contentious and fractious, but as in the fire escape window example the negotiated solution between the local authorities, contractor, client and architect was better for the over all construction project than any of the individual solutions would have been. To install the window in the drawn position would have required substantial modification of the roof structure and cost an exorbitant amount. To leave the window where the contractor installed it would have breached regulations and cause long-term catastrophic problems for the client obtaining approval for his house. The negotiations were occasionally tense between the participants with different value frameworks, although we see negotiation producing better solutions for the over all construction project.

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[388] Appendix A.3, section 3.17.

Figure 6.14 Construction effigy from Scottish Parliament construction (photo by Richard Coyne)

Within contemporary construction the historical authority of the trades that are engaged during on-site construction seems to have faded. Yet as specialisation within construction increases we are more reliant on the knowledge of these on-site trades and perhaps more beholden to Reddy's toolmakers paradigm, where there is more engagement with differing cultural knowledge and values of trades and specialists involved during on-site operational activities. Benefits from trans-disciplinary negotiation during the documented project have been observed in the form of more cost effective or better solutions. The communication that has been observed as part of this negotiation has not always been harmonious; it has been tense and occasionally the cause of frustration. Undoubtedly this is partially why much of the current research discussed in chapter two is invested in reducing negotiation during construction by increasing negotiation pre-construction. Nevertheless, it contributes to the potential for creative opportunity and arguably it continues to be found within construction as the effigy[389] in Figure 6.14 might attest

[389] At a time when the project manager changed several times in the highly publicised coverage of the construction of the Scottish Parliament, this effigy was photographed on site during construction. Although unconfirmed, in the absence of consistent leadership it is perhaps a way of representing it, with a shirt and tie-wearing effigy.

to. Although mobile phones and the practice of negotiation during construction may be problematic in some respects, the documentation that we have reviewed in this section suggests that negotiation during construction proves valuable to the over all project.

6.8.2. Challenges to authority

While negotiation may be valuable, it can also undermine authority. In this section of the chapter we look at the fluidity negotiation brings to construction and the perceived challenge to authority. Pre-professionalization we could argue that those engaged on construction sites such as trades, master builders, stonemasons etc. held considerable authority and respect as craftsmen. Elliot and Lawson both argue that post-professionalisation authority most definitely resides with participants who are predominantly based off-site within the professional roles.[390]

We have drawn from literature by Fish earlier in this chapter to provide an understanding of authority and its resistance to fluidity and change. We have also used Bakhtin to discuss the importance of distance as a tool for maintaining authority. Within the documented construction project mobile phones have been shown to contribute to the reduction of distance—both physical and metaphorical—between the different cultural domains active in the construction project. Consequently they had a positive effect on construction in relation to the possibilities for creative opportunity and the resolution of problematic situations. However, this reduction of distance may have a negative effect on authority within construction.

In the latter stages of the fire escape window example we observed a slow transition through Building Control of the negotiation of the authoritative building regulation and the practical limitations imposed by the site conditions. This slow transition involved arranging a site meeting, discussing the alternatives and the local authority holding an internal meeting to discuss the situation. Drawing from Bakhtin and Fish, slow and complex procedures that resist change contribute to the regulations retaining authority. Earlier in this same example we see the contractor

[390] For more on this see P Elliot, *The Sociology of the Professions* (London: Macmillan, 1972) p. 125-26. Also Lawson, *How Designers Think: The Design Process Demystified* p. 34-37.

dismiss the authoritative architectural drawing and progress quickly to what they conceived to be the best solution. This quick dismissal of the drawings undermines the drawings authority and the authority of its author. A similar situation arose in the structural example; where it was impossible to execute a drawing—an authoritative instrument—the authority of that structural drawing and its author the engineer, was brought into question. Mobile phones are also implicated in this questioning of authority, as they accelerate negotiations and can substantially reduce the temporal distance between a sacred or authoritative drawing or regulation and its change, thus reducing the authoritative worth of that drawing or regulation. The appropriation of mobile phones within this process makes objects of authority seem more fluid and potentially less authoritative.

Yet we have also observed mobile phones contributing positively to these authoritative aspects of construction. During the construction project SMS text messaging was appropriated as illustrated in Figure 6.13 SMS text message from architect to contractor of window and door specification, to reinforce and convey official specifications. These could only be conveyed permanently to the contractors' mobile phone handset, there were no other permanent communicative mediums on the construction site. This proved very effective for the conveyance of authoritative quantitative specification and information given the limited modes of communication between the contractor and other participants.

However using the mobile phone in this semi-official capacity was not without its problems. This was revealed when a contractor lost his mobile phone handset, which held critical contact information and many authoritative messages containing specifications that had been passed to the contractor over the course of the construction project. This weakness in the use of mobile phones for authoritative communication was in part ameliorated by the architects' use of BluePhoneElite[391] software, which facilitates the backup of SMS text messages and phone call logs from a Bluetooth enabled mobile phone handset onto a computer. The loss of the

[391] BluePhoneElite was at the time of the documentation of the construction project free to use for a small donation to the software developer. It has since changed to a free thirty-day trial after which it must be purchased. For more on this see *Bluephoneelite*, ([cited).

contractors' mobile phone could have proved quite problematic for the process, but the architect had been periodically backing up SMS messages. When the contractor purchased a replacement handset the critical information was quickly resent. This practice of backing up mobile phone messages is not common practice within construction, certainly not for the domestic scale project that has been documented here. However, once the appropriate technology was purchased, downloaded and installed the practice of backing up messages took less than one minute. This somewhat unorthodox semi-official documentation, like most text-based records generated during construction proved most valuable for retrospective analysis.

Our cultural understanding of authority as we have discussed is one where authority has longevity and resists change. Mobile phones have expedited the process of change during construction and consequently our findings confirm they can undermine authority. However, we have also observed mobile phones being used to positively influence authoritative aspects of construction by conveying authoritative information and preventing the authoritative process from causing costly and contentious delays.

6.8.3. Mobile Phones and Trace

In this section we turn our attention to the use of mobile phones in the documented construction project, we are particularly interested in *trace*, unlike other sanctioned modes of communication such as letters, minutes etc. mobile phones leave minimal trace of what was negotiated or agreed. This lack of trace means lack of accountability in terms of construction administration and organisation. Sanctioned communication during construction leaves a paper trace including correspondence by letter and fax or minutes of meetings, recording what was discussed and agreed. Mobile phones do not facilitate *trace* as effectively as currently sanctioned communication methods. During the construction project the necessary mobile phone usage could have been problematic, had a protocol not been in place to backup SMS messages. This perhaps provides an insight into the reluctance for mobile phones to be accepted by participants engaged in administrative or organisational aspects of construction.

The use of the BluePhoneElite software suggests that mobile phone usage can be traced. In this project it proved valuable when information was lost due to human error, this unorthodox record of communication proved useful. Records of communication within construction carry with them legal connotations, they are usually brought to centre stage when tensions evolve into a legal dispute, which must then invoke official documentation to prove liability. This is one of the reasons construction is typically a heavily documented and administered process and partially why the use of mobile phones is perceived negatively by those implicated within the organisational and administrative aspects of construction. However, during the construction project we see mobile phones and the documentation *trace* used in this retrospective capacity, in an instance where a mobile phone was lost and critical information had to be quickly reinstated. In this semi-official, retrospective capacity it proved useful.

This section has scrutinised the practice of negotiation within the process of construction and the role of mobile phones within it. We have framed negotiation in terms of the sacred and profane and the tensions that exist within that relationship. During the process of construction we observed mobile phones implicated along with other communicative tools in the negotiation of sacred and profane aspects of a particular situation. Participants from different cultural domains, with different value frameworks of sacred and profane then converged on a collective solution through the process of negotiation. This evidence challenges the assumption that communication within construction should adhere to a linear model and it supports Reddy's iterative communication model in the form of the toolmaker's paradigm. Within this context we must also consider client values as an important driver for change during construction. The evidence suggests the client is able to relate more closely to construction than to design, consequently the construction process should facilitate their involvement and embrace change. We have revealed in this section that mobile phones are directly implicated in the process of negotiation. They can undermine certain aspects of authority within the construction process if they are used to privatise channels of discourse. Conversely they enhance negotiation where appropriated to open channels and facilitate a more public form of discourse. Being able to document the communications that were conveyed via mobile phone also

proved useful when it was necessary to reinstate lost information. While it might not be desirable to include mobile phone usage as an *official* mode of documentation, it would seem to be beneficial to maintain some trace of mobile phone usage.

6.9. SUMMARY

In this chapter we have scrutinised the construction process and the influence of mobile phones on that process, we will summarise our finding under the thematic structure of our alternative description of construction, comprised of *function, tension* and *negotiation.*

6.9.1. Function

This chapter has confirmed that participants of the construction project used only the basic functionality of mobile phones. However, it also revealed that appropriation of simple functions did not equate to simplistic functionality. The way in which mobile phones influenced specific situations was quite complex and nuanced. This purely functional framing of construction—although revealing—proved inadequate to interrogate the complexity and the influence mobile phones have on the process of construction. For that we needed to explore the additional facets of tension and negotiation.

6.9.2. Tension

The tensions that were observed during the construction process were most constructively framed in terms of the sacred and profane. Where problematic situations arose within the nuances of the construction process they could be explained in terms of infringements into the sacred/profane value frameworks of participants from different cultural domains. By negotiating these tensions through minor transgressions into these value frameworks, participants arrived at an effective solution. The findings also suggest that client's values are under continued threat of being marginalised as software and systematised approaches to design and construction are brought to centre stage.

6.9.3. Negotiation

Negotiation proved to be a vital part of the documented construction project. Although negotiation seemed to cause tension and was implicated in the undermining of authority there was no clear evidence that it is inherently destructive to the relationships or the construction process. The evidence gathered suggests the contrary is true, problematic situations were only resolved by negotiation that enabled the different participants to converge on a solution that allowed the project to progress. The solution was not perfect by any particular participant's account. However, it was optimum as it resolved tensions between the participants and enabled progress.

Mobile phones are one of the communicative tools implicated in the practice of negotiation. They proved beneficial in terms of immediacy of contact and the backup protocol that was put in place to record communication via mobile phone alleviated some of the problems associated with mobile phone usage regarding the absence of a record of communication. This protocol created a record that could be interrogated and ensured critical information being transferred via mobile phone was recorded. Rather than being inherently destructive, the evidence shows they can be appropriated to contribute to both the privatisation and publication of communication. Mobile phones facilitate both these type of communication and unlike the message board and forum studied during the first strand of research the difference between public/private operational usage is very sublet. Whereas the first strand of research revealed sensitivity amongst the participants to the influence of public/private discourse, it is unclear if this awareness was present amongst the participants during the observed construction project in this strand of research.

This completes the three strands of the research that we set out to document in chapter three. In the first strand we documented a construction event and established an alternative description of construction, in the second strand we documented perceptions of mobile phones in construction, in the third strand we documented the usage of mobile phones during construction. In the following chapter we will draw together our findings from this documentation and compare the perceptions of mobile phones in construction with their actual usage during

construction. In the final chapter we will revisit the original aims of this thesis, asking how have we increased our understanding of construction as a creative process and the operational influence of mobile phones during collaborative on-site activities within domestic scale construction?

7. ANALYSIS OF THE THREE STRANDS OF DOCUMENTATION

This chapter draws together the findings from the three strands of research that have been carried out during this thesis. It will use the alternative description of construction that emerged from the first strand of research to compare the perceptions and usage of mobile phones, which were documented during the second and third strands respectively. These strands were intended to increase our understanding of construction as a creative process and the influence that mobile phones exert upon it. First we will briefly revisit our findings from chapters one and two, which discuss the limitations to the existing description of construction and supports the search for an alternative.

7.1. LIMITATIONS TO THE EXISTING DESCRIPTION OF CONSTRUCTION

Chapter one reviewed contemporary construction and the recent initiatives aimed at improving it. We revealed the legacy of a rule-based approach to construction has caused an inherent bias towards a linear conception of the design and construction process. Recent initiatives drew heavily from the linear manufacturing ethos of the automotive industry; consequently the construction sector adopts a similar linear approach of design followed by fabrication and assembly. The Royal Institute of British Architect's (RIBA) predominant contractual model—the Plan of Work (PoW)—also promotes a linear model of design followed by construction. Forms of legal contract used within the construction sector such as the Joint Contract Tribunal (JCT) contract also bind participants into a linear relationship, with any notion of creativity or fluidity is reserved for the early design stages. Through the writings of Vitruvius we identified a historical precedent of creativity within operational activities during construction. However, contemporary construction has marginalised its intangible aspects in favour of more easily prescribed components. Where the construction sector is driving for change, it is driving towards greater systemisation and rigidity of the linear process. We acknowledged that while this existing linear and functional description of construction is relevant within the context of this thesis, it is also problematic as its

inherent restrictions will be imposed on any research aimed at creating a description of construction that is not based on this linear model. Reviewing the current research in chapter two revealed that it also adopts a linear systematised conception of construction. This seems to be caused at least partially by the need for the research to actively engage with the construction sector discussed in chapter one.

However, a small number of research projects including Shoal Fly By (SFB) demonstrated that alternative conceptions of construction are possible and provide insights into its more esoteric processes. SFB revolved around the construction of a sculpture, which was not restricted by established patterns of behaviour inherent in the construction sector, thus an alternative description of construction was possible. We also looked at non-functional aspects of engaging with technology. McCarthy and Wright drew our attention to the experiential influence of technology, suggesting that our engagement with technology is complex and not adequately defined by function alone. Brown and Duguid added support to this proposition and continuing to argue that richer descriptions are required to describe our relationship with technology.

7.2. STRAND 1: AN ALTERNATIVE DESCRIPTION OF CONSTRUCTION

The first strand of the research aimed to establish an alternative description of construction and analyse the influence exerted by communication technology. Aware of the restrictions that might be imposed by documenting a traditional construction project at this stage, the design and construction of an art installation was documented. This project would not be restricted by the predominant linear description of construction held by the industry, nor would the participants be inclined to adopt political and litigious patterns of behaviour inherent in a typical construction project. This environment would allow an instinctual use of communication and technology and it revealed an alternative description where communicative processes were comprised of three distinct facets: *function*, *tension* and *negotiation.*

7.2.1. Function

During the construction of the art installation two communication technologies were employed. One, an informal online message board had been provided by the course organisers. The project participants created the other, a formal online forum. We observed these communication technologies functioning in very different capacities. The forum was used predominantly for intensive discourse such as the detailed interrogation of a particular subject. The message board was used for expansive discourse such as brainstorming, which would benefit from the involvement of multiple disciplines. Throughout the design and construction of the art installation both modes of communication operated simultaneously as both expansive and intensive discourse remained active aspects to the communication throughout the project.

While there was little prescribed concerning how the technologies should be used, the optimisation of communication was not in the individual functional specifics of each tool, but rather in how the participants' negotiated the usage of these two modes of communication.

7.2.2. Tensions

Tension was another facet to communication revealed during this strand of research. Steps had been taken to reduce the potential for political tension by studying a project outside the traditional construction domain and in an environment that was less politically tense. It has proven interesting within the context of this research that tensions should emerge as influence. In this instance, one of the modes of communication became designated as the official means of communication and the other mode of communication became the unofficial mode by default. Tension was created where none existed by the emergence of this binary opposition. We discovered that tension was a necessary by-product of the different functional traits of the two communication mediums, which were benefiting the project. Thus it revealed tension is not an inherently destructive aspect to communication.

7.2.3. Negotiation

Regarding the observed communication, the findings revealed there exists a formal/informal binary opposition. It is within this context that the value of

negotiation was revealed. When the binary relationship of the message board and the forum was interrogated it revealed a considerable complexity within their usage. The distinct functional affordances of the official and unofficial modes of communication have been outlined in chapter four. However, there was no distinct pattern or sequence to participants' appropriation of the technologies. The detail of the nuance and intent within each individual situation influenced participants' choosing either the message board or the forum. The creative success of this project—if we can call it that—could be attributed to the participants' understanding of the project, their needs and how they negotiated their use of the communicative tools at their disposal.

To summarise the first strand of research, it revealed three facets to communication during the proto-construction project, *function, tension* and *negotiation*. The functional facet is the only one represented within the existing description of construction, thus existing conceptions are limited to considering only the functional facet to communication. We must acknowledge that the functional facet has provided insight into the use of the different communication tools within this project. However, it is apparent from the research that the other facets also influence the use of these tools. Negotiation is implicated in the proto-construction project as a creative process, as the creative opportunity was enhanced not simply by the provision of these functionally different tools for communication but by the participants' freedom to appropriate them fluidly in any given situation.

Binary Opposite (Official)	⇦ Negotiation ⇨	Binary Opposite (Unofficial)

Table 7.1 Communicative spectrum

The three facets can be framed within the notion of *tuning* or *calibration.* Different functional components exist in a state of tension and their relationship is calibrated. Tuning as we have discussed in chapter four is defined as putting a system into the most efficient working order. Participants could tune these communication technologies to their specific requirements through their choice of a particular technology to create the most efficient communicative system. We will use Table 7.1 as a means to represent the *functional* binary opposition, the *tension* created by the binary opposition and the participants' *negotiation* of these tensions.

We will use this as a template to interrogate the additional strands of research for the function, tension and negotiation facets to communication.

7.3. STRAND 2: PERCEPTION OF MOBILE PHONES WITHIN CONSTRUCTION

The second strand of the research was made up of chapter five and focused on participants' perception of mobile phones. The aim of this strand was to document and understand perceptions of mobile phones obtained through interviews with a broad spectrum of participants involved in the construction process. This included designers, site managers, clients and contractors. We scrutinised the documentation under the themes of function, tension and negotiation.

7.3.1. Function

Across the spectrum of participants interviewed there was a consistency to perceptions regarding the functionality of mobile phones. Phone calling and SMS text messaging were widely used and the majority of interviewees perceived the main benefit being the contact afforded by mobile phones. The interviewees suggested that the mobile phone is heavily implicated in the imperative to maintain progress during construction. Participants also explained how they used mobile phones for reorganising, although it was only one of many communication tools used to reorganise people or materials. Schedules and meetings were also used to help ensure that manpower and materials were distributed effectively. In this capacity mobile phones would seem to have more currency for participants who were proximate to on-site construction activities. This was confirmed upon analysis of the interviews where sub-contractors and site managers held distinctly more positive perceptions of mobile phones than architects and construction organisation directors.

This is different to the first strand where the focus was on two distinct communication devices. These devices were revealed to have distinct functions and were appropriated differently. In this case only one device was subjected to scrutiny. However, this strand of research revealed that although there is agreement on the functional role of mobile phones, participants hold different perceptions of its influence on the construction process. Those in organisational roles perceived them negatively, those involved in on-site operations perceived them positively.

7.3.2. Tensions

Tensions existed across the perceptions of participants for the organisational and on-site domains. To understand this tensional relationship we drew from Lindsay Jones to describe the findings in terms of operation and orientation tensions. Operational activities are driven by the on-site imperative to maintain progress during construction; orientation activities are driven by the off-site imperative to maintain organisational structures and harmony during construction.

This strand of the research found that participants such as sub-contractors who are mainly involved in operational activities held predominantly positive perceptions of mobile phones. This was attributed to operational activities being invested in the maintenance of progress, thus the contact afforded by mobile phones enhanced their ability to maintain progress and minimise delay during construction. Participants such as architects who are mainly involved in orientation activities held predominantly negative perceptions regarding mobile phones. This was attributed to orientation activities being explicitly concerned with maintenance of harmony and orientation mechanisms[392] that facilitate the co-ordination of a construction project. For organisational participants, the impromptu use of mobile phones would circumvent these official mechanisms and thus cause problems for their maintenance. The tensional facet to communication in the second strand resonates with our findings from the first strand, where we found a similar tension being created between two fundamentally different needs that are required to coexist within an effective communicative system. The facility for mobile phones to be used for both publicising and privatising communication was also brought to our attention. In the spirit of public communication, participants could contact several tradesmen to assist with overcoming a problematic situation on-site. Private communication was usually the focus interviewees' attention when it caused a situation to become increasingly problematic; the dominant perception being the situation could have been prevented if the discourse had been made public earlier. This opinion was usually offered retrospective, at the instance mobile phones are appropriated for

[392] Orientation mechanisms produce and maintain drawings, schedules of work, bills of quantities and any other products that enable co-ordination between the participants of a construction project.

communication the distinction between what constitutes public and private communication is occasionally blurred. Making this distinction seemed to benefit the discourse observed during the first strand of research, where participants had to chose either the forum or the message board to communicate.

7.3.3. Negotiation

Participants' perceptions of negotiation were noticeably different. A similar table to the one found in section 7.2.3 is used to represent the operation and orientation functionality, the tension that exists between them and the negotiation of these two needs within the communicative system.

Those towards the operational end of the table were more reliant upon negotiation as part of their on-site operational activities. It was revealed as a necessary part of these activities, not because of a failing of orientation activities, but because orientation mechanisms such as drawings and schedules are not able to accurately represent all the details of a construction project. For participants engaged within operational construction, negotiation is simply the most effective way of dealing with these gaps in the information and maintaining progress.

Orientation ⇐	Negotiation ⇒		Operation
Construction Organisation Director	Architect	Site Manager	Sub-Contractor

Table 7.2 Perceptions spectrum

Participants within construction have been located along the spectrum in Table 7.2; depending on what extent their role involves orientation or operational activities. This table can be correlated with participants' perceptions, with participants towards the operational extreme holding predominantly positive perceptions of negotiation and those towards the orientation extreme holding predominantly negative ones. We could attribute these negative perceptions to the belief that negotiation during construction is a perceived failing of orientation mechanisms and thus a failing of those charged with the responsibility of their maintenance. As mobile phones increase the ability to negotiate they are directly associated with the undermining of these mechanisms and the authority of the participants charged with their maintenance. Those located towards the middle of the

spectrum, such as site managers, had more moderate perceptions of mobile phones as they are perhaps more equally involved in both aspects of construction and more sensitised to the need for both operation and orientation aspects within construction. Clients' influence should also be discussed here, evidence in this strand of research suggests they also drive change during construction and as such they are implicated in the tensional and negotiation aspects of communication and construction process.

What we revealed in this strand of research is that although the perceived functional facet to mobile phones is quite consistent across the spectrum of participants, the facets of tension and negotiation revealed some clear differences in participants' views. The tensions were between participants engaged in operation and orientation activities. Although the goal of construction is to build, orientation and operation activities achieve that goal in fundamentally different ways. The former achieves it by maintaining harmony through orientation mechanisms, the latter by negotiation when orientation mechanisms are not adequate. The difference in perceptions was brought to centre stage through mobile phones having a positive influence on operational activities and a profoundly negative one on orientation activities. Negotiation is also implicated here; as a practice that is facilitated by the appropriation of mobile phones. It is not the mobile phone per se that is problematic and divides opinion, but the unfamiliar blurring of public and private communication that emerges from its appropriation.

This strand revealed that although there is consistency in all participants' perceptions regarding the functional facet of mobile phones, that consistency does not extend to the facets of tension and negotiation. The functional facet dominates the existing description of construction, consequently it cannot militate the differences these additional facets may have on construction.

7.4. STRAND 3: USAGE OF MOBILE PHONES IN CONSTRUCTION

This strand of the research focused on the documentation of participants' working practices during construction. The aim was to increase our understanding of mobile phone usage during construction and how they are used alongside other communication tools. The author participated in a domestic scale construction

project to document the usage of mobile phones, which were found to be used extensively during construction and are now implicated in almost all its aspects.

7.4.1. Function

The functional facet of usage resonates closely with the functional facet of perceptions from the second strand of research. Only basic functionality was used during the construction project and we documented mobile phones being used effectively in three main capacities:

- It was used in an operational capacity to reduce potential delay and maintain progress. This strand of research revealed that typically in such an instance the contractor would initiate contact. Even when immediate contact was not possible a message could be left and because a call was missed the other party would initiate contact.
- It was also used in an organisational capacity to maintain harmony. This study documented participants arranging meetings and using SMS messaging to forward detailed specifications or information to others. One particular participant did not necessarily initiate this. However, the catalyst for this type of usage was usually the identification by the contractor of inconsistencies between the drawings and the site condition.
- It was also implicated in negotiation where information needed clarifying. We discovered mobile phones facilitating impromptu multi-disciplinary contact. This was not always adequate to reach a solution and other modes of communication such as meetings, additional drawings or specification may also be employed.

For this particular construction project a backup protocol was implemented for mobile phone SMS text messages. This provided an additional—albeit unusual—orientation mechanism that proved useful during the construction process. Like many orientation processes it was not invoked on a day-to-day basis. However, it did prove useful retrospectively when the contractor lost his mobile phone, which was being used to convey detailed specifications of windows and doors via SMS texts. After the lost mobile phone was reinstated it was possible to quickly query the SMS backup

and forward the specification to the contractor. This protocol was not perceived as an official record nor was it perceived as a monitoring activity, thus it did not restrict mobile phone usage. If anything, the added protection of the backup protocol meant mobile phones were used freely even for communicating detailed and critical specifications.

7.4.2. Tensions

The tension that emerged from this strand of the research could not be satisfactorily framed within the previously established binary oppositions as they over-simplified the observed nuances of communication practice. By drawing from Lewis Hyde and Mikhail Bakhtin we stepped away from the contemporary functional language of construction and adopted a pre-modern terminology. We described the observations in terms of its tensions between the sacred and the profane. Unlike the previous official/unofficial and operation/orientation descriptions, the sacred/profane description is not part of the established language of modern construction thus it could be applied to many of its components.

Of the problematic situations that arose during construction, several of which we documented and discussed in chapter six, all involved many complex factors. Clients' wishes, regulations, site conditions and the interpretation of drawings are but a few of the influential components in any construction situation. We discovered each participant within the construction project has their own unique conception of any situation and invariably attributed different values of sacred or profane to it. Situations would regularly arise where different participants wanted to proceed differently, through negotiation the participants would converge on an understanding and eventually a solution could be agreed upon that facilitated progress and simultaneously fulfilled all the participants' sacred values, although the solution might not be ideal for any one participant. Mobile phones were not always directly implicated within the negotiations of these tensions. However, as the dominant mode of communication they were usually used at some point in the chain of events leading to a solution.

7.4.3. Negotiation

Turning to the facet of negotiation, during the construction project participants' mobile phone usage did not resonate with their perceptions. During the second strand of research the perception of negotiation was divided between participants involved in operation and orientation activities. Those implicated in operational activities embraced negotiation whereas those engaged in orientation activities were dismissive and negative towards it. This strand of research discovered that irrespective of individual perceptions and involvement in operation or orientation activities, everyone engages in negotiation during construction.

Sacred ⇦	Negotiation ⇨		Profane
Regulations	Drawings	Instructions	Site

Table 7.3 Building control officers' sacred/profane value framework

Sacred ⇦	Negotiation ⇨		Profane
Site	Instructions	Drawings	Regulations

Table 7.4 Contractors' sacred/profane value framework

The findings have been represented in Table 7.3 and Table 7.4. In this case the functional facet is the individual sacred/profane value frameworks held by the different participants involved in this construction project. We can see tensions exist between the building control officers framework represented in Table 7.3 and the contractors framework represented in Table 7.4, where the participants consider different components of design and construction processes sacred or profane. Differences in these frameworks are only brought to our attention and cause conflict when construction begins and participants are working together. Rather that these tensions being avoidable, they are necessary. Arguably—based on the documentation—negotiation is a fundamental component of the construction process. Without it the official components of construction such as regulations and building approval processes and other orientation components of construction such as architectural and engineering drawings are unlikely to be sufficient to accommodate the construction process. Participants had to negotiate their value frameworks in relation to other participant's and only when they converged on a

situation that fulfilled all the sacred values within their particular framework could they proceed. Negotiation did not achieve an optimum solution for every participant involved in any given situation; it facilitates the convergence of each participant's different values into a *usable range*. When the participants converged on an arrangement where all their sacred values were within this usable range then construction could proceed. This suggests negotiation and fluidity is as valuable a constituent as systemisation or organisation.

Sacred ⇐	Negotiation	⇒	Profane
Cost	Progress	Harmony	Regulations

Table 7.5 Clients' sacred/profane value framework

The clients' value framework as illustrated in Table 7.5 is fundamentally different, probably as a result of the client lying outside the cultural framework of construction. The specialist documents used for communication make it difficult for those outwith the design and construction culture to participant in the pre-construction stages that rely heavily on abstract documentation. We have observed clients become increasingly active on the construction site as the building starts to emerge and it becomes easier to relate to it, which is suggestive of a practical need for negotiation and flexibility during construction.

In this section we have revealed that the functional facet of the use of mobile phones within the process of construction can be simply quantified. Functionally only phone calling and SMS text messaging are used, this resonates closely with the perceptions of mobile phone functionality. The tension between the sacred and profane that emerged within this strand of the research continues to suggest that tension is an influential facet to communication and collaboration. Although perceptions of the practice of negotiation were divided, during the construction process it was revealed that everyone engaged in some form of negotiation. Mobile phones were found to influence the practice of negotiation as they facilitated quick and direct communication and were implicated in the maintenance of both orientation and operational activities during construction. Unlike the other communication technology that we have discussed in this thesis, such as bills of

quantities, drawings, schedules and 3D models, mobile phones were not implicated in the abstraction of design ideas and information. They were implicated in negotiating facts and filling the gaps left by these technologies of abstraction. This strand of research revealed that mobile phones function as a facilitator of communication, which is fundamentally different to the mediation function of traditional communication technologies in the construction process.

7.5. SUMMARY

In this chapter we have drawn together the three strands of research and used our alternative description of construction to compare the perception and usage of mobile phones within construction and reflect upon construction as a creative process. In section 7.1 we looked at the existing description of construction that dominates the construction sector, which is overshadowed by its function facet. In this chapter we have demonstrated that the functional aspects of communication technology—in this case mobile phones—are easily quantifiable. However, this functional framing is an over simplification of the complexity of construction and how communication technology is appropriated within the process. The functional facet is also the only aspect of communication technology —within our findings— where the participants have demonstrated coherence and consistency between perception and usage.

7.5.1. Function

The first strand of the research demonstrated that different communication needs existed within a construction environment and participants would appropriate whichever communication mode best served their needs. The second strand of research demonstrated that only the phones' simple functionality was being employed and the third strand clearly demonstrated that this simple functionality in no way represented the complexity of usage that was observed. However, it illustrated that perceptions and usage of a mobile phone's functionality are consistent.

The rather simple functional description of construction as fabrication and assembly fails to represent its nuance. Communication technology described as a

conduit for information also falls short characterising the communicative complexity that was documented during the construction process. The functional facet was not able to adequately describe the operational influence of mobile phones within the construction process. The third strand of the research found that mobile phones perform a qualitatively different function to other communication technologies during construction; they act as a facilitator not mediator of communication. For a richer understanding of the influence of mobile phones we had to interrogate the additional facets of our alternative description of construction: tension and negotiation.

7.5.2. Tensions

The tensional facet to construction and communication technology was revealed during the first strand of the research in the form of official and unofficial communication. In what was considered a politically benign environment, political tensions nevertheless exerted considerable influence. Although there are clearly official and unofficial modes of communication within construction, the second strand of the research revealed an additional complexity to the official and unofficial aspect of communication in the form of operation and orientation activities. The third strand of research revealed communication within construction involves more esoteric influences. However, appropriating a medieval language we could embrace these communicative tensions within a sacred and profane value framework. During construction, aspects of the sacred and profane are resolved by negotiation, the participants converged on a common understanding and thus were able to make progress. The varieties of culture and skill that converge during construction contribute to its' potential as a creative process. However, negotiation and fluidity are resisted within the existing description of construction and thus the potential for newness within construction can be somewhat restricted. The findings add weight to the case advanced by Brown and Duguid, who claim there are complex layers to knowledge and information exchange. These aspects are often excluded or rigidly prescribed in simplified and abstracted models to reduce the possibility of tensions and the unforeseen, but it also reduces the potential for creative opportunity.

7.5.3. Negotiation

The first strand of the research revealed that the negotiation of any situation and the modes of communication chosen where based on the specific nuances of each situation. The participants had a reasonable understanding of their aim and their choices of communication technology were informed by that knowledge. It was not possible within the confines of this thesis to map a fixed framework for the successful negotiation within the project, but inline with Wingers supposition of complexity the findings suggest that communication was based on many varied and esoteric factors.

The second strand of the research revealed different perceptions regarding negotiation. Participants such as contractors actively involved in operational construction embraced negotiation as an active part of their role and mobile phones enhanced their ability to carry out their work effectively. Participants actively involved in orientation activities such as architects and managers within construction had negative perceptions of negotiation and were actively pursuing ways to expunge it from their working practices. Mobile phones were perceived as a tool that enabled participants to respond to a situation rather than organise and thus prevent it arising. Consequently mobile phones are perceived as undermining orientation aspects of construction, particularly where prolonged privatisation of a particular situation eventually resulted in becoming considerably problematic.

The third strand of the research demonstrated that perceptions of negotiation and mobile phones did not resonate with usage. It was clear during the construction project that some aspects of fluidity existed, all participants from the local authorities officer to the engineer and contractor demonstrated that there was room for negotiation on many aspects of the construction project. These negotiations resulted in either reducing delays, producing a more cost effective solution or allowing client intervention. The findings continue to support the metaphor of instrumental or mechanical *tuning* as a process within which we can couch the role of mobile phones within construction. They are used to achieve a state where several components be it formal/informal, operation/orientation or sacred/profane exist—perhaps sub-optimally—within an acceptable usage range of values, which facilitates an optimum

working relationship between two or more participants. Like a stringed musical instrument or mechanical engine the functional components individually exist in tension with each other yet the overall collaboration of components as a whole appears harmonious.

Having drawn together the three strands of research in this chapter, the next and final chapter will reflect on the initial aim of this thesis and draw together our conclusions regarding construction as a creative process and the operational influence of mobile phones within construction.

8. CONCLUSIONS

In this chapter we will address the initial aim of this research project, to increase our understanding of construction as a creative process and understand the influence of mobile phones within domestic scale construction projects. We will summarise our findings concerning construction and mobile phone usage under the themes *function, tension* and *negotiation.* When selecting methodologies in chapter three we discussed how it might not always be reasonable to generalise research of this nature, which follows a qualitative tradition. Key to the transfer of findings from this type of research is rigorous documentation, which we have endeavoured to record throughout this thesis. This enables the reader to assess if similarities allow these conclusions to be transferred to other similar projects, or to gauge that any parallels are idiosyncratic.

This thesis has aimed to increase our understanding of construction as a creative process. The literature review in chapters one and two revealed the existing description of construction, which dominates the construction sector. This description was heavily reliant on a functional framing of construction and following the evidence presented in this research it has been revealed as being only a partial description. Chapter three established an appropriate methodology for the thesis and outlined three studies that would achieve its aims. The first study was aimed at establishing an alternative description of construction; this was documented in chapter four. The second study was aimed at understanding the perceptions of mobile phones within construction; this was documented in chapter five. The third study was aimed at understanding the use of mobile phones within construction; this was documented in chapter sic. Chapter ten drew together the three strands of research and revealed that communication could be described as a trinity of function, tension and negotiation. However, during the three studies we only found consistency through the functional facet to communication. Perceptions of the tensional facet were clearly absent from the interviews conducted in the second strand of research. Yet during the third strand of research this facet was clearly identifiable and its influence on the documented construction project was particularly clear. Perceptions of negotiation were polarised in the second strand of research, yet in the third strand

all participants embraced negotiation and it proved to be a key component in successful execution of the construction project.

These multiple facets were resolved within the conceptual metaphor of tuning. Although distant from construction it acts as a structure that not only allows us to frame construction as a creative event but also engages with all the facets of the communicative trinity, not just the functional facet that dominates the existing description.

8.1. THE DOMINANCE OF FUNCTION

In this section we will summarise the functional facet of construction, its role within communications that occur during construction and the influence of mobile phones on it. We also discuss the limitations of this facet within the existing description of construction.

8.1.1. Construction

From the literature review we could abstract construction to three functions. Firstly *design* of an object, secondly the *representation* of that object and thirdly the *construction* of that object. The first strand of the research challenged this linear functional conception of the design and construction process. We found that design was not limited to early stages of the project but continued throughout the construction of the art installation. As ideas were represented and even constructed, new combinations of possibilities would emerge. Arguably these ideas could only surface when construction started, as it was the juxtaposition of particular components during construction that stimulated the continued design activity. In the second strand of the research we see managers and designers who were interviewed subscribe to the perception of design and construction as a linear process. However, builders and other site-based workers interviewed did not subscribe readily to this notion. They were more flexible when considering design and more receptive to change when engaged in construction. In the third strand of the research a building project was carried out in accordance with the RIBA Plan of Work, with the clear intentions of executing this project to the RIBA's linear cannons of good practice. The findings from this strand resonated with the findings from the first strand. In

both projects the components of design, representation and construction were occurring fluidly—not linearly—throughout the project. The fluidity during the construction project—as documented in chapter six—often resulted in more effective solutions from either a cost or design perspective.

Considering construction as a creative process does not necessarily mean discarding the functional conception of construction. This thesis has demonstrated that a functional description of construction is only one facet to communications within the process and represents only part of the overall description. This thesis promotes theories advanced by the likes of Wenger; Brown and Duguid; McCarthy and Wright, who argue that richer description of our interactions with technology are required. The findings support the proposition that the existing description of construction would benefit from being broadened to embrace additional facets—such as tension and negotiation—which have emerged during this research.

8.1.2. Mobile Phones

Communication technology facilitates the transfer of information within construction. Within this functional description these technologies are conceived as tools for the conveyance of information from one person or location to another. This thesis has focused on mobile phones, but our definition of communication technologies also includes e-mail and other media. We also include in our wider description of communication technology drawings, fax, schedules and letters, these too are technologies that facilitate the transfer of information. However, they are perhaps more established within the traditional design and construction processes than mobile phones. All these communication technologies are implicated throughout the construction process, from establishing the initial design goal, through the planning of the construction process, to the monitoring and maintenance during the construction process.

In the first strand of the research we identified clear functional traits that could be attributed to the communication technologies that were being used. The unstructured message board facilitated public *expansive* trans-disciplinary contact between participants within the project. The structured forum facilitated private more *intensive* interrogation of a subject. These communication technologies were

appropriated depending on the participants' particular expansive/intensive communicative needs in any given situation. However, the dynamics of the usage was not as easy to define as the functionality. In the second strand of the research we found that perception of mobile phones extended only to being useful for phone calling and SMS text messaging. Although there were some exceptions, the general perception amongst all the participants interviewed was that being contactable was the main functional benefit from adopting mobile phones. In the third strand of research the themes of public and private re-emerged. Inappropriate privatisation caused situations to escalate and become problematic, this is in contrast to more appropriate choices observed during the first strand of research in which participants had a greater sensitivity and awareness to technology.

Mobile phones were implicated in a wide range of activities during the construction process, from specification delivery to reducing administrative delays. This functionality that mobile phones bring to the communications within construction are quite simple, which is quite deceptive. The evidence suggests that simple functionality does not accurately represent the complexity and influence that they exert on the nuances of working practices within the construction process.

8.1.3. The Dominant Description

This functional facet to communication is the only facet represented within the existing description of construction,[393] which dominates the construction sector and much of the current research. It emerged during the first strand of research that functionality does influence participants' choice of communication technology. This hypothesis was supported in the second and third strands where the functionality of mobile phones for enhancing contact with others proved very influential in its appropriation during construction.

We have discovered that the *perception* and *usage* of mobile phones' functionality are very similar and quite accurate, thus the existing functional description of construction as a basis for future research is not necessarily flawed. However, this thesis has revealed that mobile phones operate in a different capacity

[393] For more on this see chapter 2.

to other communication technologies, which could not be satisfactorily represented within the limitations of the functional description of construction. It is through the additional facets of tension and negotiation that the complexity of communication and the influence of mobile phones during construction are revealed.

8.2. THE ABSENCE OF TENSION

In this section we will summarise the tensional facet to communication during construction and the influence of mobile phones within it. We also discuss why the absence of this facet from the existing description of construction is potentially problematic.

8.2.1. Construction

During the first strand of research political tensions were discovered between groups involved in administering the online forum and those involved directly in the construction process that continued to use the online message board. The designers of the forum appointed it the *official* mode of communication for the project and the message board automatically became *unofficial* by proxy. This was particularly insightful as this project was chosen because it was not beholden to the traditional political and litigious tensions of a typical construction project. However, even in this politically benign environment the official/unofficial tensions influenced the communication patterns of the project.

During the second strand of the research we continued to find tensions. Within participants' perceptions we identified an official/unofficial tension, which had been brought to centre stage earlier by the first strand of research. However, this did not fully represent the complexity of the findings; the participants' perceptions were more accurately framed with the help of theorist Lindsay Jones in terms of *orientation* and *operational* tensions. Orientation is the provision and maintenance of organisational structures for the construction process, such as revising drawings and updating changes to designs or schedules. Orientation is highly valued by designers, managers and administrators, participants that are predominantly based off-site. Orientation activities are distinctly different to operational activities, which value the maintenance of progress during the construction process. These activities are more

highly valued by builders and sub-contractors, participants who are based predominantly on-site. Unlike orientation activities, operational activities are not heavily prescribed, they are more fluid and in the research documented here they usually resort to verbal discussion to negotiate problematic situations. When described like this we see an obvious potential for conflict as participants based on-site maintaining operational progress may not see the need to maintaining orientation structures.

During the third strand of research we documented both official/unofficial and orientation/operational aspects to construction and to communication. However, there could be many different influential factors involved in each unique situation. For example, cost, site restrictions and personal experience are but a few factors that influenced participants during the construction project. The tensions observed during actual operational activities during construction were most constructively described with the help of Mikhail Bakhtin in terms of the *sacred* and *profane*. When something was conceived as sacred by a participant it was considered fixed and not negotiable, changing it was rarely even considered. If something was considered profane it was benign or ordinary and would be readily changed by participants. In the fire escape window example we documented in chapter six the building control officer held the building regulations sacred, the architect held the drawings sacred and the contractor held the site conditions sacred. Within this example the participants negotiated and manipulated aspects of the fire escape's windows size and position to create a window in a location that fulfilled the sacred value framework of all the participants, thus enabling progress to be maintained. With different participants and different cultural domains within a construction project it was not unexpected that participants had different value frameworks regarding what was important (or sacred) during construction. In situations that became problematic these value frameworks were usually different, but were always negotiated to allow the project to progress.

Tension between the participants during construction has been revealed as a by-product of the different sacred/profane values that the architect, contractor or engineer bring to the construction process. The potential to arrive at effective and

creative solutions relies on their participation and thus relies on tension. However, the evidence presented within this thesis suggests participants may only be conscious of the negative influence of tension and not necessarily aware of its critical contribution to the construction process.

8.2.2. Communication Technology

The first strand of research revealed a tension between the two communication technologies that were being used. The unofficial message board afforded expansive communication and the official forum afforded intensive communication. This schism was quite distinctive as there were two different technologies being employed.

Having been sensitised to this distinction, the second strand of the research focused on a single technology and revealed that interviewees held equally distinctive perceptions regarding mobile phones. There were more positive perceptions held by the participants engaged closely with operational activities within on-site construction, such as sub-contractors. Predominantly negative perceptions were held by participants who were engaged closely with orientation activities within off-site construction, such as designers and the directors of large construction organisations. The latter preferring structured and established forms of communication such as drawings, schedules and to-do lists, for their organisational activities; mobile phones circumvent these established forms of communication and were thus perceived negatively. Being more sensitised to the possibility that these structured and official modes of communication may potentially be insufficient, sub-contractors valued mobile phones as an important tool in obtaining detail absent from drawings and instructions. In this respect we see the mobile phone creating tension as it has the potential to simultaneously influence orientation activities negatively and operational activities positively.

In the third strand of research we identified a distinction between the mobile phone and other communication technologies. Communication technologies used for orientation—such as drawings—*mediate* the communicated information. The necessary abstraction of information for mediation makes drawings understandable by different participants, which makes them an effective tool for orientation.

However, by doing so the drawing may not contain sufficient information to convey the nuances of the design between different participants. When this occurred we observed participants appropriate mobile phones, which *facilitate* rather than mediate communication thus enabling them to quickly obtain the missing information.

The examples documented in the third strand of research have revealed that mobile phones play a valuable role in problem solving, even when not directly involved in the negotiation of a solution. The structural example[394] demonstrates how they were used and found to be unsatisfactory. This had the effect of causing the participants to quickly call a meeting, in which they resolved the issue. The third strand of the research also revealed limitations to conventional communication technologies. In the staircase example[395] the architect forwarded three drawings to the contractor, each with a greater level of staircase detail. Yet communication mediated through these abstracted drawings failed to contribute to the resolution of the situation. This process of mediation was not addressing the insufficiencies in the information. Through focusing on mobile phones this research has drawn attention to the dual communicative requirements of mediation and facilitation. Mediation is best supported by traditional communication technologies such as drawings; facilitation is supported through more direct forms of communication technology, such as mobile phones.

8.2.3. Absent from the Dominant Description

Unlike the functional facet, the tensional facet to communication within construction is not represented within the existing functional description of construction. The fire escape window example[396] that we discussed in chapter nine demonstrates the many different expertise and cultural domains of designers, engineers, builders and administrators that exist within construction. We have discussed how tensions are a necessary by-product of the need for these different expertises. The second strand of the research revealed that mobile phones are

[394] For more on this see Appendix A.3, section 15.18.

[395] For more on this see Appendix A.3, section 15.17.

[396] For more on this see Appendix A.3, section 15.16.

perceived and used differently within these different cultural domains. The influence of mobile phones extends beyond a simple conduit for the transfer of information. We have revealed that they are implicated in cultural differences and tensions, which have not been possible to articulate within the existing description of construction.

The existing description of construction is based upon an assumption that participants have similar values and understanding. Construction information is then conveyed through standardised orientation devices such as drawings and schedules, which provide an abstracted representation to assist with collective trans-disciplinary understanding. This thesis has challenged this assumption and the tensional facet to communication suggests that the presumption should be that participants hold different conceptions that must be negotiated. It is within this cultural and social framework that the complexity of construction is revealed. It is only within this framework that we can demonstrate mobile phones facilitating communication and convergence within the nuances of negotiation alongside existing technologies for mediation.

8.3. THE ERASURE OF NEGOTIATION

In this section we will summarise our findings on the facet of negotiation within communication during construction and the influence of mobile phones. We also discuss how attempts to expunge this facet from communication could potentially be problematic.

8.3.1. Construction

Negotiation emerged as a key factor during the first strand of the research. The functional traits of the message board and forum that were deployed during this stage of the research were relatively easily defined from our observations. However, the participants negotiated effectively through their selective appropriation of these technologies, which contributed to the successful collaboration and the evolution of creative and inventive ideas. The creative potential within collaboration was released not through adherence to a prescribed communicative protocol but through the participants' fluid appropriation of the most effective mode or modes of communication for their purposes.

During the second strand of the research we revealed differing perceptions amongst participants regarding negotiation. Participants removed from on-site operational activities such as designers and directors of large construction organisations perceived negotiation negatively. They perceived that the need for negotiation represented a failing in the organisational aspects of construction that is typically their responsibility, thus a need for negotiation is perceived as a type of failure. Participants engaged in on-site operational activities such as builders and sub-contractors accepted negotiation as part of their working practice; this has the effect of producing an ideological tension between these two groups of participants. Whereas some interviewees such as directors and architects resist and try to minimise negotiation, other interviewees such as builders embrace it as a highly valued working practice. Mobile phones are directly implicated in the practice of negotiation and consequently perceptions of mobile phones were aligned with perceptions of negotiation within the construction process.

In the third strand of the research we found participants periodically suspended these ideological tensions regarding the mobile phone. We found that all participants periodically engaged in the practice of negotiation, irrespective of their attitude towards it. The staircase example discussed in chapter nine illustrates how the architect prefers continued delivery of drawings and resists negotiation to resolve the staircase design. Eventually however, he succumbs to a face-to-face meeting with the contractor and the matter is quickly resolved. During the fire escape window example we find the local building authority officer willing to negotiate on the building regulations, but only when it became apparent that they could not be practically implemented in a specific situation.

Arguably none of the sacred orientation devices such as drawings and regulation were adhered to precisely during construction, the sacred values of all the participants occasionally had to change. We have likened this negotiation to instrumental or mechanical *tuning,* as there is not an apparent exact state of the components or of participants' values in the examples documented. Rather we see a convergence on a state that eventually fulfilled all sacred values, at which point progress could continue. Many of the drawings and the participants' value

frameworks regarding regulations or components had to be re-evaluated during construction either because the site condition demanded they changed. As construction progressed solutions emerged that were attuned to the precise site conditions and individual circumstances, thus the intended design was tuned accordingly. The third strand of research brought evidence to bear that challenges existing conceptions of the clients' place in the design process. They would seem to relate much better to construction and so it would seem restrictive to make construction more rigid or to invest further effort in elaborating design descriptions; at least in their current abstract form, alternative design descriptions may be more useful. There is an argument to be made here to employ three dimensionality for design and not just representation.

The findings suggest that negotiation is not inherently problematic within construction, although it does cause tensions usually because it is perceived as the product of failure and thus should be avoidable. Contrary to attempts to expunge negotiation from construction, this research points to negotiation as being fundamental to the construction process. We have established that relationships between components or participants can only exist through negotiation and their periodic tuning and maintenance.

8.3.2. Communication Technology

During the first strand of the research two different technologies emerged that had two different functional qualities. A participant's negotiation could be charted relatively clearly though their choice of technology for communication as one afforded expansive discourse and the other afforded intensive discourse. During the second strand we focused on a single communication technology in the form of the mobile phone. We found that participants involved in on-site construction were more sensitised to the need for negotiation and were more receptive to mobile phones. Participants removed from the construction process perceived negotiation negatively. They equated it with conflict and poor organisation, because mobile phones enhance negotiation they were also perceived negatively.

During the third strand of the research we found that the use of mobile phones and the need for negotiation was not always a direct result of poor

organisation. Mobile phones were employed to maintain progress, minimise delays and find more effective solutions to situations that could not have been anticipated during either the design or representation phase of the project. The facilitation of communication between the different participants and the negotiation of effective solutions implicates the mobile phone in the release of creative potential during construction. In the previous section we liken this process to tuning, this research then points to the operational influence of mobile phones being similar to a *tuning device* that maintains working and harmonious relationships.

The main problem that emerged during this strand of the research was the concern for the absence of any meaningful trace or documentation of communication via mobile phone. However, the backup protocol that was implemented during this project facilitated the tracking of SMS text messaging. It was not always practical or possible to give written confirmation of critical decisions; as such information was confirmed by SMS rather than in writing. The backup protocol proved valuable as it provided a record of this information, which was required to reinstate the information when the contractor lost his mobile phone. This additional security also enabled mobile phones in this instance to be used quite freely in the knowledge that there was a secure record of critical information. The evidence that has been brought to light in this study suggests there are benefits for construction from being inclusive regarding the practice of negotiation and mobile phones operating within these working practices.

8.3.3. Erasure from the Dominant Description

Contrary to the findings, the existing description of construction and much of the current research that was reviewed in chapters one and two is invested in expunging negotiation from construction. Our findings suggest the construction sector perceives negotiation as problematic, costly and reflecting poor organisation. Trends within the current research suggest that technological developments will continue to attempt to expunge negotiation from the construction process.

This thesis suggests that situations can become more problematic if negotiation is not facilitated. Problematic situations can be minimised and resolved much faster through fluid negotiation rather than through official prescribed

channels. Abstraction is necessary at a macro-scale within construction for organisation and orientation of participants and relationships through the provision of general drawings, schedules and bills of quantities. However, the findings suggest that at a micro-scale construction benefits from negotiation to tune the detailed nuances of those same relationships. This research has found the micro-practices of negotiation and tuning exist symbiotically and are no less import to construction than the macro-practice of abstraction and organisation. Arguably as the tools of abstraction and organisation increase, so should the tools for negotiation.

8.4. HOW HAVE WE INCREASED OUR UNDERSTANDING OF CONSTRUCTION AS A CREATIVE PROCESS?

This thesis has challenged the ubiquitous industry assumption that design and construction are linear sequential processes; it supports the notion that linearity of these processes is not a prerequisite for success in construction. The facets of *function*, *tension* and *negotiation* that have been revealed here as being influential factors in construction as a creative process, have also been revealed as being influential factors in construction as an efficient process. The construction project documented in chapters eight and nine revealed that these facets also affected *efficient* negotiation and *effective* problem resolution. This suggests the factors that shape construction as a creative process are similar to the factors that can assist with improving construction as an efficient process.

In chapters one and two we established that the facet of *function* dominates the industry's existing description of construction and frames it as a fabrication and assembly process. Chapter four challenged this description and revealed that the processes of design, fabrication and assembly were carried out throughout the construction process. Only during the traditional construction processes of fabrication and assembly were certain design solutions found to be problematic. Participants then returned to design processes, redesigning with the additional information that only came into being during construction. These finding strengthened our position that the functional aspect to construction does not fully represent the intricacies of construction or communication. Our evidence supports the position that the existing description of construction is not necessarily flawed; it

is merely restricted to the functional facet, which is the easiest to quantify. Chapter five revealed the tensional facet to participants' perceptions is not represented within the existing description of construction. Consequently this description does not represent or address the social and cultural aspects that have been found to drive tensions within the construction process. Chapter six revealed *negotiation* as a valuable practice within the execution of construction. Understanding the complexities of participant negotiation in terms of the sacred and profane enhanced our understanding of it. Again we found the existing description failing to reflect the complexity and nuances to the practice of negotiation within construction.

The themes of public and private communication were brought to out attention within the findings. Mobile phones present a new opportunity for communication and currently they would seem to be altering communicative boundaries between public and privatised discourse. The choice made by participants during the first strand of research to use either the message-board or forum draws attentions to the value of their dissimilarity. This distinction was blurred when mobile phones were used in the construction project during the third strand of research; evidence suggests an awareness of this distinction can benefit communication.

Although the functional facets of the construction process and the communication technologies involved were influential, they only represent a fraction of the relevant factors that have been documented in this thesis. Problem solving during construction required collaboration between different participants. This collaboration was a catalyst for professional as well as social and cultural tensions. Being able to converge on an effective solution required the negotiation of those tensions. Continuing the theme of negotiation we find it has added currency in relation to clients' values. The cultural gap between the design team and clients causes clients to be marginalised, particularly during design when communication and representation is abstracted and specialised. It is in this regard that negotiation during construction has particular value as it facilitates clients to participate as the construction process translates the design into a universal spatial description that can be understood without difficulty. The alternative description of construction that we

established and which comprises not only function but also tension and negotiation provides a description that includes these facets of construction and communication and establishes a framework of inclusion for the different cultural influences that operate within design and construction.

As well as discovering similarities in the factors that influence construction as both a creative and efficient process, this research has challenged the dominant functional description of construction; and communication within it as linear channels for the transfer of information. The findings point to construction existing as a complex system driven by perpetual tensions caused not only by functional but also professional, social and cultural forces. These forces mean the relationship between the components of design, fabrication and assembly are constantly being revisited, rethought, recalibrated and retuned. Trying to describe these dynamics in terms of just function has proved inadequate. Rather than being inherently destructive these forces are managed and their relationships tuned through the practice of negotiation. The construction process relies on rigid formal components organised to achieve the construction of a building. However, it also relies on informal flexible constituents that can attend to the small imperfections that are inherent in these formal elements. It is in this capacity that we can best describe the influence of mobile phones.

8.5. HOW HAVE WE INCREASED OUR UNDERSTANDING OF MOBILE PHONES WITHIN OPERATIONAL ACTIVITIES DURING CONSTRUCTION?

Chapters one and two reviewed the current state of construction and of communication technologies such as drawings, letters, e-mail, PDAs etc. within it. In this review we found they were almost exclusively being integrated into *official communication* channels, and used almost exclusively for *orientation* purposes by enabling *expansive* communication through *mediation* and the abstraction of information. Chapter four established a broader usage of communication technology. As well as a need for expansive discourse to assist with orientation, the participants also required and engaged in intensive discourse to assist with the interrogation of details. During the first strand of research two different technologies, the forum for

intensive discourse and the message board for expansive discourse facilitated this. Both communicative functions were required throughout the project.

Chapter five revealed that participants engaged within operational on-site construction were reliant on the intensive discourse to clarify and *fill in the gaps* caused by the abstraction of information from drawings. Participants disengaged from operational on-site construction such as managers and designers were dismissive of this intensive communication and more invested in the production of documentation—such as drawings—for expansive communication. Mobile phones are heavily implicated in this intensive communication for the interrogation and clarification of detail, as such participants like sub-contractors who value intensive discourse perceived mobile phones positively. Participants like architects who value expansive discourse perceive mobile phones negatively. These perceptions are partly driven by the mobile phone's association to intensive and expansive communicative processes.

As we have mentioned previously communication technology is widely found appropriated into official working practices of design and construction. Usually it is employed for orientation purposes or the production of orientation material such as drawings and it is used in expansive discourse to mediate between different disciplines. This research has established that mobile phones do not follow this *official – orientation – expansive – mediation* trend. They are not as yet indoctrinated into official communication channels, they remain *unofficial* and they are implicated in *operation* rather than orientation activities, they are often used for *intensive* not expansive discourse to resolve detail through communication by *facilitation* rather than mediation. Mobile phones do not perform the same function as rigid official communication technologies within the process of construction; consequently we should not consider them the same.

Mobile phones facilitate communication through the interrogation of detail within the construction process. They do not function—as many other communication technologies do—as mediators of communication through the abstraction and removal of detail. Nor did mobile phones operate in a fixed capacity; they were used fluidly as participants required, in this respect they behaved more as

tuning devices that maintained working relationships between the fixed components during construction. This thesis supports McCarthy and Wrights supposition that technology should not be separated from experience. It advances Starlings claim that design takes place not in the human or object but in a landscape where this distinction is blurred, the technosocial.[397] The social aspect to communication and technology advanced by Wenger and independently by Brown and Duguid has also been revealed to have currency within design and construction. Evidence suggests that this domain is complex and theories that seek to advance construction should resist the urge to structure or simplify, instead it would seem critical that they engage with its propensity for randomness and the arcane.

Conceiving of mobile phones not as a fixed component with a fixed place within the process of construction but as a tuning device enables us to consider it within a paradigm with the other communication technologies within the construction process but to resist quantifying its influence as the same. This provides a description of communication technology and mobile phones within construction that is more representative of the construction process and the usage of these technologies as it has been observed during this thesis. This thesis has created a richer description of construction and the use of communication technologies as a base for future interrogation of this subject matter.

8.6. FUTURE WORK

Phone calling and SMS text messaging were the only aspects of mobile phone functionality exploited in this research, it is unclear if this is a result of additional functionality being unnecessary or simply unintuitive. Recent developments in touch screen technology as implemented in the iPhone and the Android open source mobile phone platform developed by Google may provide future opportunities for more usable and programmable interfaces and more intuitive access to additional features. Reducing the need for specialised knowledge and training to use sophisticated functionality may shed light on other functional benefits afforded by mobile phones. In addition to mobile phones other technology continues

[397] For more on this see Bruce Sterling, *Shaping Things* (Cambridge: MIT Press, 2005) p. 9.

to evolve, solid-state laptops and palmtops continue to become more robust and more feasible for widespread deployment on construction sites. Mobile phones continue to become more like handheld computers that incorporate GPS, video and sound capabilities. This hardware gets blended together; Tweed has presented one example of this convergence, which reveals new operational potential for these devices.[398] The notion of convergence also extends to potential junctions through more conventional means, and the new potential they might bring to collaborations within the construction process.

This research was particularly interested in mobile phones and concentrating on where and how they are implicated within the process of construction. This limited study shows they can contribute to positive aspects of creativity and efficiency in the construction process as well as the publicised negative aspects in relation to health and safety. Given their proliferation, there should be further investigation into the effects of removing of mobile phones from construction sites, it may cause new as well as solve old problems.

The interviews and case study suggests a complex communicative network operates during construction to resolve problematic situations. An extensive investigation of these communicative networks was beyond the scope of this research project. Nevertheless a more substantial *trace* of phone usage on a larger scale could help shed further light on the dynamics of the relationships within construction as facilitated through mobile phones and other communication technologies. This would bring more evidence to bear in understanding their influence on problem resolution. These professional networks are not immune to the surge in social networking websites such as MySpace and facebook in the past five years, one wonders about professional networking spin-offs such as http://www.myhammer.co.uk. Sub-contractors, particularly sole operators network to solve problems, there are many more emergent social and networking hardware and software that warrant future study.

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[398] Mai, Dodds, and Tweed, "A PDA-Based System for Recognizing Buildings from User-Supplied Images."

As to whether a permanent trace of mobile phone activity would be a practical or desirable development remains unclear. New technologies, like e-mail was considered in the early 1990s, become indoctrinated into working practice and become beholden to traditional legal requirements, invariably the freedom these tools once afforded becomes diminished. A similar fate would undoubtedly befall mobile phones if they were indoctrinated into official communication channels, they would unquestionably cease to function in the manner observed in this thesis.

The notion of *spectating* within construction requires further research. In light of much of the current development of sophisticated software for managing construction, participants become further removed from the intimate processes of a construction's working practices. Pirsig warns of the dangers of becoming spectators that disengage from the process. Bakhtin also warns of disengagement, claiming that the key factor in carnival is participation. The separation of carnival into spectacle and spectators and forcing these components to disengage transformed a potent creative event into a benign holiday spectacle. However, this is a more fundamental question regarding the attitudes of the construction industry in relation to communication technology and the effects these attitudes might have on future research, construction participants and working practices of the construction process.

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10. APPENDIX A-1: ART INSTALLATION

What follows here is a record of an Art Installation which was carried out as part of the MSc in Design and Digital Media course at the University of Edinburgh. Firstly in Section 10.1 there will be a description of the project, its aims and how it was executed by the students over the course of six weeks. As this thesis is interested in communication practice, what follows in sections and is a log of the discourse which took place on a general message-board (Section 10.2) and on a bespoke purpose build digital 'forum' (Section 10.3) designed explicitly for this project. Finally when the project was complete we gathered a small group of the participants together in a focus group (Section 10.4) to reflect on the Art Installation and the communication tools employed during its execution.

10.1. THE INSTALLATION

The project was devised by the course The project was group orientated and was presented to the students with a particular theme, more as a provocation than a directive, students were encouraged to post suggestions for its development on the course message board. The students refined the theme, designed and created the Installation. We allude here to a six-week project carried out by thirty-three postgraduate students at the University of Edinburgh between April and June 2004. The students were enrolled in an MSc in Design and Digital Media and the installation project was part of the MSc course submission.

10.1.1. The Aim

The aim was the creation of an Art Installation, which would be open to the public, this would required the negotiation of three components. Firstly agreeing a theme. While the course organisers provided a provocation for the installation, the precise conceptual ideas were left up to the group. Secondly, designing the installation, there are various aspects to the design and the group engaged in designing and negotiating each part of the Installation into the whole concept. Finally the assembly of the installation in space which was commandeered by the students and used as an exhibition space.

Groups were designated by the course organisors, specific tasks based on the direction of the installation concept and the likely requirements the realisation of such an installation would demand, Student gravitated towards the particular sub-groups they had a particularly affinity with and wished to participate in. They were encouraged to work together and cross-communicate.

10.1.2. The Six Weeks

Initially the themes of weather and threshold were presented to the group, more as a provocation than a fixed concept for the project. There was an initial meeting of the entire group of students where this provocation was discussed and what the final outcome or aim might be.

Following this meeting, the course organisers suggested sub-groups which would specialise in particular elements of the installations requirements. There was a survey team, interactive team and on-line log team amongst others. As the organisers wanted the class as a whole to regulate the numbers in each sub-group they asked that individual expressions of interest for each sub-group be posted in the message board.[399] Figure 9.1 illustrates the timeline and the different elements of the project, while a project like this is superficially linear, in as much as a theme is agreed, then it is designed and constructed, there is-at a more detailed level—considerable over lap of the different elements. Even the sourcing of materials in week two impacted on the design[400] and development of the Installation.

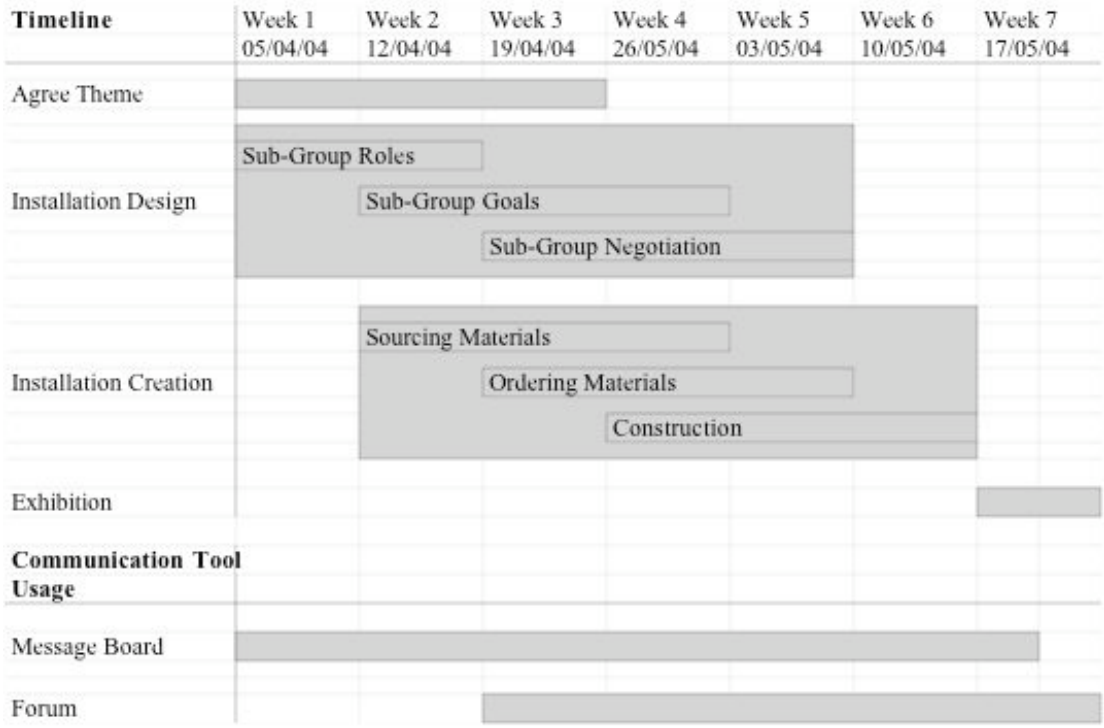

Figure 9.1

Over the next few weeks the concept was teased out on the message-board[401], a communication device we will describe and discuss in more detail below. During this period the central idea of *change* and appropriating *umbrella*s emerged[402] and became the driving force for the installation. Although the themes of change—

[399] See Appendix A.1, section 10.2 message [212]

[400] See appendix A.1, section 10.2 message [223]. Following some early discussion the purchase of rubber was deemed too expensive, and a cheaper alternative was considered from a very early stage.

[401] See Appendix A.1, section 10.2 message [224]. This discussion continues sporadically, interspersed amongst other conversations on the message board.

[402] First mention of the umbrella is in appendix A.1, section 10.2. message [289], but this received support in several following messages and eventually the author of the idea commits to it and pushes ahead see section 10.2 message [295].

according to the date stamps on the messages—and the umbrella motif were decided in the first two weeks of the project the details of the installation evolved and morphed long after this period.[403] This was in part due to the details of the 'Installation Design' element, where the sub-groups were defining their roles[404] and negotiating their relationships with each other in relation to maintaining the overall theme.

During the following weeks as the practicalities of the installation were starting to crystalise the student were engaged in securing a venue to hold the installation, and modelling it virtually to get a sense of the space. Also the sub-groups were starting to create materials and make them publicly available for inspection and discussion[405]. It was also around this time that the volume of traffic using the forum—which we will discuss in more depth in Section 10.3—which had emerged in the second week was increasing.[406] The forum was a more structured environment, with calendars and categories, where each sub-group had a location to post messages and upload files (Figure 9.3).

In the final weeks of the Installation, with the venue secured the work of constructing the installation dominated.[407] before culminating in an opening event[408] with students, friends and academics from inside and outside the course. The installation remained open for one week following the opening event before being dismantled.

10.1.3. Communication Technologies

When the project started, the students had at their disposal an informally structured digital notice board (created using a MySQL database and ColdFusion). The last message posted on the message board appeared at the bottom of the course homepage (Figure 9.2), which was highly visible as it was set as the default homepage on all the Internet browsers on the course computers. A complete message list could be viewed easily if required, and no security measures were in place.[409] Anyone could contribute.

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[403] See Appendix A.1, section 10.2 message [339] for discussion of a late idea regarding live weather data.

[404] See Appendix A.1, section 10.4 [04:01]. The Spatial groups role was misunderstood and late in the project they were redefined, partly by group pressures, and undoubtedly partly because of the desire to submit a valid course submission for this project.

[405] See Appendix A.1, section 10.2 message [298]

[406] We see the first mention of the forum on 20/04/04, see Appendix A.1, section 10.2 message [254] but we start to see much more usage from 05/06/04, see Appendix A.1, section 10.2 message [320]; [321]; [327]; [250].

[407] Starting with Appendix A.1, section 10.2 message [344] and continuing for several posts the focus is on materials (projectors, screens etc) and consumables (crisps etc.) for launching the installation.

[408] See Appendix, A.1, section 10.2 message [355]; [356]; [357].

[409] More recently a security code must be typed in when posting a message, this became necessary to avoid 'spamming', see Appendix A.1, section 10.2 message [156]; [157]. But during this project no such measures were necessary.

In contrast to this message-board, by week two of the program a more structured web-based "forum" (Figure 9.3) appeared, designed by students in the "log team," deploying the ColdFusion database environment that had featured in the learning in a previous term. This forum was divided into sections corresponding to each of the designated groups. Each section had a calendar and upload section. Each section was then further subdivided into topics, which anyone could add to. The students were initially encouraged to use the message board to post ideas for the installation, as the forum was not available, later on when the forum emerged sub-group were encouraged by the forum architects to use it with posted to the message-board which redirect the reader to the forum.[410] It became used regularly for more in-depth discussions between individual groups[411] where specifics and details could be explored or requested. Subsequent to the installation project we conducted a focus group to study to assess how individuals within the groups used the two forms of digital communications in the project.

Figure 9.2 Message-board

Figure 9.3 Forum

10.2. MESSAGE BOARD ARCHIVE

What follows is the archive of messages from the message-board. Because of the extensive usage of this communication tool for matters not explicitly related to this project, messages which have no bearing have been omitted,[412] for this reason there are gaps in the numbering where large blocks of unrelated messages have—for economy of space—been removed. We have retained some 'interruptions' to the message sequence, where others have intervened with a differing request or even a completely unrelated posting[413] as this is part of the nature of the medium and has relevance to its usage.

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[410] See Appendix A.1, section 10.2 message [285], there were several attempts like this to encourage the group to use the forum for all communication, including general discussion.

[411] See Appendix A.1, section 10.3.4 where the Survey team are discussing video clips. Also section 10.3.9 where the specific proportion of one of these video clips is discussed by the Interactive team as they.

[412] For example, see Appendix A.1, section 10.2 message [79] – [209] were related to the previous project submission and so were omitted.

[413] See Appendix A.1, section 10.2 message [287], an 'interruption' on the message board.

[385] COLD FUSION book. Does anyone have this? Nixon 2:40 PM Thu 26/08/2004

[384] Really smart site ... digital stories ... great sounds and pics ... Nixon http://www.digitalfiction.co.uk/digitalfiction/ 11:57 AM Tue 24/08/2004

[383] good luck in your presentations everybody, Irish eyes are smiling..... Dan 1:14 PM Mon 08/23/2004

[382] i have borrowed 'Lingo Sorcery' from the lab. if you need it urgently call 07752096296 francis 6:11 PM Fri 10/08/2004

[379] Hey guys, have a look at this game.. Aragon http://www.antiwargame.org/ 10:57 PM Tue 20/07/2004

[378] a pretty neat visual presentation of a thesis on synaesthesia in flash alexis http://www.sinnich.de/ 11:14 AM Tue 13/07/2004

[377] Very intersting flash project here. Dexter http://surface.yugop.com/ 2:57 PM Tue 12/07/2004

[376] To Henrik or Bob, i am working on a small Flash movie, and i would like to add some sound, do you have any sounds you would like to share with me, with all the ackowledgments of course. If you would like to discuss this matter, please drop me an email to arrange, my address is; mcsot@yahoo.com I am not even sure if you check the message board but couldnt think another way to get in touch...Thanks George 1:8 AM Tue 12/07/2004

[373] The GODS are exstatic !!!! - Today we all celebrate with the best of Europe. ΕΛΛΑΔΑΡΑ ΣΑΓΑΠΩ !!! Aragon :) http://www.euro2004.com 4:0 PM Fri 05/07/2004

[372] Beyond Max Headroom... SIGGRAPH 2004 conference + computer animation festival teaser trailer! Dermott http://www.siggraph.org/s2004/conference/caf/index.php?pageID=conference=conference# 9:26 AM Fri 05/07/2004

[359] Thanks, Juan! Will see how to put it in. Joan 11:39 AM Fri 21/05/2004

[358] Joan:The MOV file,Cheers Juan http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/train.mov 4:5 PM Thu 20/05/2004

[357] Hi all, I am sorry i didnt do this before. I just emailed everyone about the rota of the installation space.I will also put it on radiowipe. Miro 1:47 PM Thu 20/05/2004

[356] Yes, it was a great evening. Well done everyone. Just one question. Is there a ROTA for the supervision of the installation space, I recall seeing one literally

floating around the installation room. If there is one could someone please make it available online, on the forums if possible. Thanks. Dexter www.radiowipe.co.uk 10:0 AM Thu 20/05/2004

[355] Well done everyone. The opening was a great event. The space was bustling, the installation/s seemed to provoke a lot of discussion. No doubt there will be some feedback from visitors ... Nixon 8:12 AM Thu 20/05/2004

[354] Thank you Nixon. I've taken some sound parts off. Jock 2:10 PM Wed 19/05/2004

[353] Looks like there will be some great stuff on show .... just a reminder of our rule on sound sources. These have to be generated in-house and cannot by shareware resources from the web, etc. Nixon 8:33 AM Wed 19/05/2004

[352] Finally, just finished my project for the eMac. Special thanks to the survey team for providing gorgeous pictures :) Jock http://ddm.caad.ed.ac.uk/~JLi/inst/inst.swf 5:9 AM Wed 19/05/2004

[351] hi - we have got beer, coke and crisps for tomorrow nite. No wine unfortunately - but you may bring your own supply if you so wish! Jones 9:38 PM Tue 18/05/2004

[350] We built the Radio WIP(e) Website to collect and keep record of the working progress of the installation, the Website includes news section, online forums, calendars, and upload pages for each team and the whole project. Online Log Team(Luke, Dexter, Yin, Jeffery, Joan) 12:55 PM Tue 18/05/2004

[349] Interactive visual architecture for dual projector, working with motion tracking data and sensor input. 3D models and flash animation responding to weather data and sound. - if you need more find Luke, Mel, Aragon, or Jock. interactives. 11:46 AM Tue 18/05/2004

[348] Video footages, pictures, sounds, composition of city, weather data... Probably, you cannot touch what we did, but we hope that you can see and feel how the things are changED. Survey Team 4:4 AM Tue 18/05/2004

[346] ATTENTION ALL MAX/MSP/JITTER people: I have written a patch for receiving motion tracking, sensor and weather data over the network. It is a patch called receiver and listens to messages accross the network and parses them appropriatly and sends the data through outlets. It can be found in GroupFolders/DDM Group/Max/receiver. A standalone motion tracking application sends the data over the network from one of the emacs, there will also be a stand alone for all the sensors (4 floor sensors and door) (I haven't managed yet to make it into a stand alone but will have that done tomorrow, and it will run from the same emac). Bob's patch for parsing Kevin live weather will also send over the network but I haven't quite had the time to do that one but it will be a stand-alone running on the same machine. The motion tracking patch, sensors patch and weather data patch all use a 'sender' wich is

set to send the data to the IP of the G5 on the balcony, one of the emacs on the balcony and have room for one more user chosen IP. I'll be here from about 11ish to help. Henrik 11:32 PM Mon 17/05/2004

[345] We are producing flight troughs of representative spots in Edinburgh. We are using 3d modeling and video editing for the projection of them. The models to show represent the castle, the forth bridge, the dungeons, New town, and one of the tipical passages in the city (steps) Simulation team 9:26 PM Mon 17/05/2004

[344] Hi - We are in the process of writing a leaflet for people attending the exhibition giving a more detailed explanation of what we our doing and who we are. For this however we need all of you who are contributing to the actual installation to contribute a few lines detailing what you are doing. We will edit this into a leaflet tomorrow, so we would be very grateful if you could have this done by then. It does not need to be an individual submission - a group one will be fine but it is important that all the aspects of the installation are covered. Thank you. Events Team 4:36 PM Mon 17/05/2004

[343] SPACE UPDATE: Hello digitals. The space team have fetishised the space with black plastic and the interactive team appear to have got motion tracking flourecent umbrellas working. Luke has brought down the G5 for dual projectors and there is a fully working 6 channel + sub speaker system in place. Not heard from the people making emac slide shows yet but it would be good to see what you have got today (monday). Also, it would be good to discuss the 3D fly throughs and sound options with those directly involved. The publicity team need to buy bottles of beer and get them cold for the opening and reminder emails need to be sent to anyone who you want to come and see the opening/installation. I am around on Monday and Tuesday to help out with these things but wont hang around if I'm not needed. Joseph 10:32 AM Mon 17/05/2004

[342] George, there is no version of the poster on line but if you really want it i could send it to you. Also, the site is www.chang-ed.co.uk Miro http://www.chang-ed.co.uk 12:4 PM Fri 14/05/2004

[341] Hi everyone! Is there any version of the poster (prepared by the Publicity Team) available on line? Also, is there any website for the installation, if so, what is the URL? Hope everyone's ok. Thanx :-) George 6:51 PM Thu 13/05/2004

[340] A flash movie, feel free to use it if u r interested.Source file is in Survey Team's "UPLOAD FILES" in radio WIP. Juan http://ddm.caad.ed.ac.uk/~DZhang/flash/train.html 1:5 AM Thu 13/05/2004

[339] Henrik and I have been discussing the possibility of using live weather data from a site Kevin has found to modulate some sonic aspect of the installation (weather-based soundscapes being created by Pete). Kevin, have you made a script to extract the data? I'm working on a way to communicate this to

Max/MSP (via Open Sound Control) and so need to know what the nature of the data will be. Could you let me know which parameters (pressure, temperature etc..) you will be sending and how often? If it updates every 30 minutes we could have a 30 minute delay and ramp slowly between values so that they are constantly changing which might be interesting. Henrik said Aragon also might be able to help with this? Thanks, Bob 10:34 AM Sun 12/05/2004

[338] the photos LUKE requested,good luck! Survey Team http://ddm.caad.ed.ac.uk/%7EDZhang/pic/page_01.htm 8:11 PM Fri 11/05/2004

[328] new studio model simullation team http://ddm.caad.ed.ac.uk/~YWang/installation/studio.dcr 12:49 PM Fri 11/05/2004

[327] Some weather effect videos.hope it helps Survey team http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/messages.cfm?&Category=1&id=161 3:46 AM Thu 08/05/2004

[326] Hi,digitals!! I need your assistance! I will make the 3D model of the Edinburgh Castle. I have already collected some images about it. But I need more. If you have any photos or other images about the Castle, could you please email or pass them to me. My email: Z.Xie@sms.ed.ac.uk Ronnie6:40 PM Mon 07/05/2004

[324] Hi,digitals!! I need your assistance! I will make the 3D model of the Edinburgh Castle. I have already collected some images about it. But I need more. If you have any photos or other images about the Castle, could you please email or pass them to me. Ronnie5:12 PM Sat 06/05/2004

[323] www.radiowipe is now updated with news and content about what teams are doing. It should have all the info by the end of the day, we also hope to have a live streaming JUMBLED RADIO Dexter www.radiowipe.co.uk 4:20 PM Sat 06/05/2004

[322] New spatial team's proposition is here spatial team http://ddm.caad.ed.ac.uk/%7EEMichalaki/changed/spatial_propo.htm 3:57 PM Sat 06/05/2004

[321] is there any requirements about the resources (any kind) of the installation ? please leave your message on the wip(e). survey team 2:47 PM Sat 06/05/2004

[320] I have post the message about Baltic Exhibition in our WIP forums, please go to Luke http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/messages.cfm?&Category=2&id=145 11:17 AM Sat 06/05/2004

[319] Yesterday I have visited some of Hiller's installations at Baltic (the international centre for contemporary art, Gateshead, near to New Castle) www.balticmill.com/html/viehil.html The one called Witness is particularly interesting for me, basically it's a large, dark room with lots (over one hundred I suppose) of pendent speakers (of the same size) that the top part are fixed on the ceiling and connected to sound database. These over one hundreds speakers are playing records simultaneously in that room giving a very different impression to the visitors. I have noticed that those records were telling stories in different languages (English, French, and Russian? And more), I also find that the voice recorded are different, some are female voice and some are male voice, some voice sound older and some sound younger. I can't tell whether they are telling the same story. Walking through these speakers or standing at different positions will get different effects and impression. It was great experience and maybe you can get some inspiration from it. (See this photo, which is taken from the Baltic public website http://www.balticmill.com/flash/imageBanks/current/hiller1.html and also go to this link for more information http://www.artangel.org.uk/pages/past/00/00_hiller.htm Another exhibition also quite interesting is called Clinic. The room is large, bright and empty (about too floors high) with several huge speakers allocated at the two side. When a visitor approaches the speaker it starts playing someone's record about his/her own story. All these stories are collected from individuals from a wide range of cultural backgrounds who believe they have died and returned to recount their near death experiences. I haven t got enough time to explore more in that room but I guess it would be more interesting when more and more visitors come into that room and more and more speaker start playing the stories, eventually you will get confused about whose story are you listening to. Also see this page for more information http://www.balticmill.com/html/viehil.html Combine the inspirations that I get from the above two exhibitions I think maybe we can set up several speakers in our installation room, when a visitor has triggered the sensor it start playing record (e.g. the weather report speech randomiser that Dexter and matt have developed) or some meteorologic sound such as rain, thunder, wind and so on. Or maybe we can setup several speakers around a visitor/ several visitors (in the corner or the centre of the installation room) and play different meteorological sound at the same time, providing visitor different impression or experience by the various weather of Edinburgh. It's just an idea, maybe not only use speakers we might use projectors or combination of both sound and animation, or something else. Luke 11:11 AM Sat 06/05/2004

[317] For those who need climate change statistics, we have uploaded two files of climate statistics on wip(e) forums. One is Edinburgh daily temperature record for a whole year and another is the mothly temperature change in scotland from 1961 to 2004. You can download these two files in the WIP(E). Kelly (survey team) 9:47 PM Mon 04/05/2004

[316] Here you can download spatial team's presentation and videos YvonneAlexisDebbie

http://ddm.caad.ed.ac.uk/%7EEMichalaki/changed/index.htm 3:30 PM Mon 04/05/2004

[315] having to design a poster, it would be good if we could have the full version of Photoshop CS installed on these machines. anyone else agree? event team 1:5 PM Mon 04/05/2004

[314] oops... just figured out that i've missed a "d." I mean changed.uk.net Kevin 2:36 AM Mon 04/05/2004

[313] I think maybe change.uk.net Kevin 6:12 PM Fri 03/05/2004

[312] To someone who can need it, the dimensions of the dome are: exterior 3.4 wide, 2.30 height, Interior: radious=1.5, 2.25heigh, and 3.0 wide. The projector thing has 0.80 height. There is some interesting totorials for use it and render for it on that site Ross ftp://ftp.elumens.com/public-marcom/animation-how-to/ 2:45 PM Fri 03/05/2004

[311] The model making video is on radiowipe now, as I had some problems on the previous location Yvonne http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/model1.mpg 12:11 PM Mon 01/05/2004

[310] You can look at the model making video on Yvonne http://evaluna.info/temp/model1.mpg 11:46 AM Mon 01/05/2004

[309] i like changed.eu.com francis 6:8 PM Fri 30/04/2004

[308] More image analysis software for jitter - check it out Joseph http://www.iamas.ac.jp/~jovan02/cv/ 2:50 PM Fri 30/04/2004

[307] I listen to radiowipe at home, in the office and in the car! Luke 12:28 PM Fri 30/04/2004

[306] OK, I don't want to force the issue, but let's use the forum set up, there are sections for each team and general seciton for everyone to use and it's taken a lot of time to get it together. I have posted some important information on the general post in regards to our team that all teams should read. Please follow the link. Dont forget..www.radiowipe.co.uk is where it's at. Dexter http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/messages.cfm?id=101&Category=7#101 12:23 PM Fri 30/04/2004

[305] Check this out - A Fountain of Light Jones http://www.gorbetdesign.com/proj_lileo.html 9:50 PM Thu 29/04/2004

[304] www.radiowipe.co.uk - use it www.radiowipe.co.uk http://www.radiowipe.co.uk 5:18 PM Thu 29/04/2004

[303] morning! here's our team work and my own one... Joan (Online Log team) http://ddm.caad.ed.ac.uk/~CWang/resources.html 10:36 AM Thu 29/04/2004

[302] Resources and other material will be presented tommorrow. Obviously there is only a practical aspect of the submission.. :) INTER@CTiVE TEAM 7:13 PM Wed 28/04/2004

[301] Survey Team Submission Juan,Kelly,Kevin,Wei,June,Werner http://ddm.caad.ed.ac.uk/~DZhang/ResourceCompilation/SurveyTeam/index.html 6:55 PM Wed 28/04/2004

[300] My resource compilation (consisting of two Max/MSP patches; LeakSpringer, a water-drip environment generator and SoundErosion, a patch that extracts frequencies at a time from sound loops or inputs, gradually 'dissolving' it) can be found in the /Sound Group folder within Group Folders. I'll be demonstrating them tomorrow but anyone interested (who has access to Max/MSP) is of course welcome to take a look. Bob 5:8 PM Wed 28/04/2004

[299] Events Team Resources Events Team http://ddm.caad.ed.ac.uk/~AHenderson/publicity/resources/ 4:55 PM Wed 28/04/2004

[298] If anybody is interested i've placed my resource compilation in Group_Folders/Sound_Group Henrik 4:31 PM Wed 28/04/2004

[297] Here are our resources Simulation Team http://ddm.caad.ed.ac.uk/~YWang/installation/studio-resource-3dmodel.html 4:30 PM Wed 28/04/2004

[296] Hi everyone, this is my Resource Compilation in a web page. Please, look to it and tell me your comments. I tried to copy it in the group folder but there is no folder for this homework. Many thanks... Jeffery Smith http://webdbdev.ucs.ed.ac.uk/ddm/2004/FSmith/MediaRes./index.htm 11:45 AM Wed 28/04/2004

[295] I'm going ahead with the umbrella idea by the way.. Henrik 11:28 PM Tue 27/04/2004

[294] I was just thinking it would be neat if we could write (or get our hands on) a jitter patch that converts any video signals to the right format for that big semispherical projector screen (in real time perhaps). Has anybody looked into the technicalities of using that big spherical projector screen? Is there allready a way to do this? There's alot of potential.. Henrik 11:22 PM Tue 27/04/2004

[293] Testing 123... The MySQL server has been upgraded to 4.0.18. Please report any problems to geoff. Geoff Lee 1:26 PM Tue 27/04/2004

[292] Hi Digitals We are looking into digital video techniques in the session at 2pm today. If there is time we might improvise a secondary session illustrating

haptics (joystick) and jitter video playback. See you at 2. Joseph Joseph http://www.avid.com/products/xpressdv/video/video_window.asp?vidName=xdvediting&videoID=85 12:53 PM Tue 27/04/2004

[291] We are also with you Henrik :-) Eve 12:14 PM Tue 27/04/2004

[290] Henrik! Yeah, that's genius. I'm with you, all the way, we just have to buy lots of umbrellas. This idea is a great transition between the "transitions" and "weather" themes. Good. in/////////out. Luke 1:46 AM Tue 27/04/2004

[289] Brainwave: We lend every visitor an umbrella, but we don't tell them what it's for. They then wonder around the installation about weather and stuff holding an umbrela. And they will wonder why. Personally I think that is genius. Who's with me? Henrik 1:42 AM Tue 27/04/2004

[288] Hi guys, could somebody please turn the heating down a bit. WE ARE BOILING HERE! Spatial team (especially desperate Debbie) 1:34 PM Mon 26/04/2004

[287] Hello, there is a new function of uploading files in Radio Wip(e) Forum. It's rough but it works. There you can upload and view your image, video, audio, or any other files. Please make the best use of it(and the forum!!) as we need various kind of resources!! Yin Joan Dexter Jeffery Luke http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/index.cfm 7:29 PM Sun 25/04/2004

[286] A question, having adopted this (slightly generalised) "Weather" theme have we disccarded the urban/city/threshold themes, or are we doing a combination (erosion and city etc)? Henrik 5:28 PM Sun 25/04/2004

[285] Hi, I have posted a message here Dexter http://webdbdev.ucs.ed.ac.uk/DDM/2004/Radio%20WIP(e)/forum/messages.cfm?id=92 9:17 AM Sun 25/04/2004

[284] Hello! We just finished the "real" model, and we'll leave it in the big room which is not anymore ours (the storage room) for any team wants to see it, together with different materials. spatial team 4:3 PM Fri 23/04/2004

[283] Here you can find links for "changED" video. Yvonne http://ddm.caad.ed.ac.uk/~EMichalaki/changED/index.htm 11:24 AM Thu 22/04/2004

[282] hi, another idea, i thought maybe we could prepare some highlighters or pens or maybe watercolors for the visitors to leave their words, messages, names, whatever they like after they've seen our installation on the wall. Just an idea! team 7 10:53 AM Thu 22/04/2004

[281] Hi all, my ideas are in the forum : Joan http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/messages.cfm?id=87&Category=7#87 10:36 AM Thu 22/04/2004

[280] sorry - entered address incorrectly! Jones http://www.anark.com/gallery 10:34 AM Thu 22/04/2004

[279] Hi, this is idea from 3d Model group, if u have good comments, u can add on the messager! Ross ,Ryan, Lily, Ronniehttp://ddm.caad.ed.ac.uk/~YWang/studio-project.htm 9:52 AM Thu 22/04/2004

[278] Like Luke I think we can use the eMacs to great effect - if it were possible, connecting them together to create a 'wall' of monitors and making one large image could be impressive(we have access to the workshop). I still like the weather idea, i'm sure this has been mentioned, but we can just use the data as a constant stream for an installation, not necessarily to do some sort of weather thing. The theme of change in Edinburgh is a good idea. As a side note - look at this link for software - impressive Jones www.anark.com/gallery 8:54 AM Thu 22/04/2004

[277] The change is a dynamic process of a city. As a cultural and historical city, Edinburgh is well-known for the coexistence in both traditional and modern issues of it. Every year, there are many kinds of festivals in this city and many people from different countries join these festivals. This makes Edinburgh is becoming a cosmopolitan place. So we can regard these festivals as one of the symbols of contemporary Edinburgh. In our project, we can use changED as the theme. Apart from the ideas which have mentioned by some members in the class such as homeless in the city, comparison between now and past days, can we also contribute some elements relevant to the festival events in Edinburgh? For example, we can create a small game. This game supplied some resources like sound, music, stages, and virtual performers. The audiences can organise a virtual performance with supplied resources and contribute it. Then the audiences will attain the further information about the city or a permission to enter the rest sectors of the exhibition. Juan June zhang 3:33 AM Thu 22/04/2004

[276] The idea ChangED is great, and what i think is to let the audiences affect on the changing. We can make use of the projector to project a dynamic image of the city of Edinburgh, and it changes base on the changing of audiences and their behavior(for instance the amount of people in the exhibition room, people's actions etc), we can use different ways to detect the changing such as video cameras which can detect audiences' movement tells how crowded it is now, eMacs which contains some interactive games of Edinburgh can send player's results to the pc which controls the projector. All the datas we get will affect on the dynamic image we projected, may be with the increase of audiences the outside of the city building become more timeworn and the street become crowded, the outlook of the city changes because of the contribution of

audiences by playing interactive games during their visit, and so on. The changing can be incogitable since audiences' actions are unbeknown, it is also the epitome of real world. Juan 1:0 AM Thu 22/04/2004

[275] Hi all. I'd like it if we could use a group of the eMacs for the installation for interactive purposes. I think that would be one effective interaction area, plus we have so many that most people will get a chance to participate even at the busiest times (in adition to the sensors). Also, i'm not a fan of the physical partitioning fo the room, but if we go down there and someone shows me a possible configuration, i could be convinced. I think a lot of people would benefit form another trip down there, now that we have some direction. I like the idea of changeED and using raw numbers from the city street for abstract works and visualizations, whether it'd be human traffic (age, average speed, volume, cars) weather, wind, light... I am excited by the jitter 3-d possibilities as well as the blue screen things that jitter can do. Also, maybe we can explore the point of view of different groups of people who experience the city in different ways. Office employees, old ladies that never leave the house, students, shopkeepers, tourists. We might have to flip the city on its back and look at the grimy underbelly. Also, if we were to do entropy, we would have to really get into the implications of the second law of thermodynamics. i'm not up for it. Luke 12:8 AM Thu 22/04/2004

[274] These are some of the resources that i would like to share them with you Jeffery Smith webdbdev.ucs.ed.ac.uk/ddm/2004/FSmith/test/test1.html 10:0 PM Wed 21/04/2004

[273] Hi everybody! I think that an instalation that explain the interaction between humans and nature is interesting. Thoough we should not get restricted by that. It would be interesting to present the influence have people on weather change and vise versa. Do you remember an advert, which suggested that a person's actions in one plave affect the climate in another place? the reverse influence is evident in people's emotions and behaviour, interactions and reactions to climate conditions. As i suggested in the class a set of eMac arranged in a route way , where people can spend time would be interesting, they would easily find the route and depending on the time they spned on each computer (that sends data and affects somehow the end-result), they produce a weather forecast, a mini-climate of their own. Then ofcourse this mini-climate would affect their emotions/reactions which would be cool to be recorded somehow. The idea of domestic and public could be also incorporated, people have different reactions when they are inside than outside. for instance, in the case of rain, people tend to try to escape when outside whereas somehow observing/enjoying its beuaty (if there is any..) from the window. This domestic/public would be interesting to somehow/physically established in the instalation room. Anyway, i should thank Joseph for alloying more than 25 words to be written because at times i get carried away. Over and out. ps. the artist, i mentioned last time is the Norwegian Mildrid Djupvik, see Wallpaper March 2004 (i am afraid no digital link provided) George 7:2 PM Wed 21/04/2004

[272] I think that splitting the room in two is not a good idea as it is not big enough and contains many elements (windows, switches, radiators, etc). However I would propose to frame one of the semi-transparent fabrics we saw yesterday and have a projection on it. We could also have two different frames so that the same projection changes until reaching the wall. I like the "changED" title and idea but especially concentrated on erosion. I agree with Henrik who mentioned erosion of the mind and of the values of society, and I find very interesting to add ENTROPY* as technological erosion. (*entropy in which I am interested now- is about the way digital or magnetic data are getting older. It's a kind of technological disorder. I.e. when a videotape gets older, "red" -colour- tends to get out of its borders). Yvonne 6:33 PM Wed 21/04/2004

[270] Just to say that the web log and calendar is great and is a really useful resource for us. Super work, thanks a lot! Joseph http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/index.cfm 6:22 PM Wed 21/04/2004

[269] What i had in mind was to divide the space in 4 or 5 sections, not just 2, the first section would involve the use of 3 cameras from different angles, to get the expectator projected in real time, and mix his/her image with videos of Ed. and 3d movies, passing form one scene to the next while activating sensors, and making the audience form part of the projection. The screen would be divided on 3 the one in the middle would be the front view, but the others wuold ve lateral views so it wuold get the sensation of traveling into the space while mixing videos and perspectives. In the next stage i liked the idea of using weather features by using more traditional istalatios, as ligth and sounds, but all related to the weather in edinburgh, and making deformations or blooming of buildings and sculptures. The third stage would be a projection again of something very abstract, but weather related in some type of game, like playing god. The last one-two sections, i still dont figure out them. As a team we'll have a propossal as well Ross 5:47 PM Wed 21/04/2004

[268] I think we should combine urban with weather. Because whether is one of the features of the city. As the room is not big enough, I don’t think we have to split the room. Actually, the balcony in the room can be seemed as a threshold. We can assume that it belongs to a house in the city somewhere. When people look down from the balcony, the room downstairs is ‘the outside.’ We could give people a feeling of that room is actually outside. We can do some technical work (using sounds, vedio&) to the windows, doors, ceiling...make the room more like "outside.” Robert 5:23 PM Wed 21/04/2004

[267] I like ChangEd theme a lot. It'd be interesting to explore the outside/inside duality and their respective environments of change/stability. What's particularly interesting is Mel's point that many of the thresholds we perceive are in the mind (a more optimistic view in the context of the homelessness theme we're also exploring). This point makes me less keen on partitioning the room with a visible, literal threshold (as do the practical difficulties we've

already discussed). But I know I'm in the minority on that. Bob 4:21 PM Wed 21/04/2004

[266] Hi, I am still in the process of thinking in some thing,however, I would like in addition to what my friends said that we add the social dimension as genuine part in the instulation. This in my opinion will add extra values to the project subject. I would like to say that I am collecting some still and moving images resources and building a page to demonstrate them. Jeffery Smith 3:47 PM Wed 21/04/2004

[265] What I would like to do is taking a video of a homeless guy as an introduction of the exhibition and we can put it at the entrance of our building. We don't really need to show the video as different people would come in different time. So we can place a scrapbook with the frames of the video, or make a film-rolling machine which is like the old-fashion cartoon and let the audiences play it. Then may make some decorations on the pathway to the exhibition room. Decoration can be positive films of snapshots of the homeless guy in the city of Edinburgh. We can make use of the lightings in the corridors and stairs to make projections of those snapshots to the walls. I like the ideas ChangED. The contents of the exhibition can be the change of Edinburgh and those contrast/threshold we can see in Edinburgh. In that sense, the room can be splited not only in 2, but in many sectors. It makes the room become a maze. The audiences would have different experience when they walk inside the maze. These experience can be what Man said like the breeze, different visual effects, light changes, sound changes (I believe Matt has recorded some sound of wind from Author's Seat ;^)). These experience can be dynamically controlled in real-time by the weather data we get. To make the room into a maze, we don't really need to split the room physically. When the audiences walk inside the maze, sensors on the floor would trigger different events with data of time and space. Kevin 3:45 PM Wed 21/04/2004

[264] Yes please do.. It's a good resource and could be great if used. Dexter http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/index.cfm 3:21 PM Wed 21/04/2004

[263] We should start posting on WIP(e) from now on for general comments and to also observe how other teams are progressing. Aragon 3:10 PM Wed 21/04/2004

[262] More or less we all agree in spliting the room in half in order to simulate the threshold - seems good. I like the idea of change whether this is urban and domestic, old and new or a maybe a combination of the two. Errosion can fit in as well this being an attribute of the theme. A question is: Does the change progress from the first half to the other or do both halves involve a simultaneous change on their own ? Aragon 3:6 PM Wed 21/04/2004

[261] i would like to stick to the idea of domestic and urban. i can see the room been split in two halves where each half represents the two contrasting ambients. a blend of visuals, lights and sound effects would then emphasize the idea of

indoor and outdoor, shelter Vs exposure, safety Vs danger, warm Vs cold. francis 2:17 PM Wed 21/04/2004

[260] I like the themes of change and urban environments and errosion (really just a kind of negative change), (but let's not limit it to weather erosion, we could have the errosion of anything; errosion of the mind (getting old), errosion of values in society...etc. I like the name changeED, the theme of change all by itself might be too general however, so coupling it with either urban environments, or a specific errosive change theme, or both is a good idea. Henrik 1:55 PM Wed 21/04/2004

[259] Right, I'd just like to put in again the idea of using the alcove in the wall to project footage of the Edinburgh closes cut together. Then having the speed of the film be determined by how fast people walk up and down on two pressure sensors. I think that it would be neat to divide the room up both visuall and with effects a more subtle threshold. However those two shouldn't overlap too much. That is playing abit with the idea that the thresholds we see aren't nearly always the 'real' thresholds. We're so often unaware of the situation of things around us. So yeah the foam sheet (if we can get it) wouldn't cover the entire room. It might even be close to one corner with just a small space behind it. Then the real threshold would be stretching all across the room but be less tangible. More just determined by some other effects. Sara 1:47 PM Wed 21/04/2004

[258] We were discussing the "changing" theme this morning and this obviously implies having two sides. Maybe the threshold should not appear too obviously to the visitor, meaning that the he/she has influence but not realizing or seeing a direct physical devision. Based on these thoughts we were thinking that the title could imlpy what the visitor can expect, not specifically but grasp the general thought. Therefore we propose : ChangED ... Of what kind of nature this change of the city migh be is still very open eg. Luke's proposal about the different face to the city (new/old), the weather changing, the noise at different times in different places, erosion ... whatever changes the face of the city could be considered... Debbie Alexis 12:40 PM Wed 21/04/2004

[257] I think the form would be simple and straightforward. I agree to spilt space into two parts by using a kind of material or several kind of material or a real model in the middle of the room, which could be projected something onto it. It would be interesting that the wall is kind of transparent, people standing in both side could see how the people on the other side react without knowing what they are watching. The theme i think could be just simply presenting the city, Edinburgh, wherever it shows unique stuffs. Such as the weather, the history,etc. I think the thing mapping the viedo onto a 3D model Joseph showed us is quite interesting. We could map different videos onto different 3D models which match the theme of the vedio. It would be also interesting to project different theme onto different kind of materials or real 3D shape models to make it more expressive. In order to let visitors feel involved, we can generate something in reality space to response the videos, such as using a

fan to generate breezing; using lighs to generate the sunrise and sunset; sprinkle water to let people feel rains, and so on. http://webdbdev.ucs.ed.ac.uk/ddm/2004/MWang/move5/firstpage.html 12:30 PM Wed 21/04/2004

[256] I agree with Luke's idea. For instance we can modeling traditional(maybe ancient) and modern city center of Edinburgh,and present the city's developing and expanding from ancient city to modern one through hundreds of years. Ryan 11:28 AM Wed 21/04/2004

[254] Hi... The online log team have been working very hard for the last week to get this site up and running, so please please please use it. It's got a great calendar/forum section for each team and then a general forum and general calendar. We'll soon have an upload section on the site. We have lots of plans for the site with streaming and other things to come. Luke, Dexter, Jeffery, Yin, Joan http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20WIP%28e%29/forum/index.cfm 6:58 PM Tue 20/04/2004

[253] Not sure if this was mentioned in a class last semester but I think this idea by ex students of M.I.T could be of use to us - I like the idea of using live data to indicate change, weather data or otherwise Jones http://www.ambientdevices.com/cat/index.html 4:34 PM Tue 20/04/2004

[252] I don't know why I like this, but I do. Dexter http://www.totalmuseum.org/webproject8/rain_on_the_sea.html 1:54 PM Tue 20/04/2004

[251] I just came across this ... a map of the software war going on between Microsoft and others. Amusing, if nothing else. John http://www.atai.org/softwarewar.png 10:55 AM Tue 20/04/2004

[250] Just thought i'd do the obvious thing and look up threshold- 1. A piece of wood or stone placed beneath a door; a doorsill. 2. An entrance or a doorway. 3. The place or point of beginning; the outset. 4. The point that must be exceeded to begin producing a given effect or result or to elicit a response: a low threshold of pain Jones 3:46 PM Mon 19/04/2004

[249] In response to Kevin's question, I was thinking that the sound/light jam would be a one night only (two if we have trouble filling time) performance. It would be good to possibly 're-use' some of the stuff built for the jam, except have the audience use them to make them sort of create their own light/sound stuff, have that set up the rest of the time. That sonic 'chick' idea may be a bit silly, but I defenitivly want to do some funny stuff. Henrik 3:41 PM Mon 19/04/2004

[248] I agree and yes indeed we do have the main theme/concept but it's no good unless we have a definite idea of what the installation will contain. If for example it was the latex/lycra screen, or a giant chick like Henrik said or the idea of the homeless guy, then you could not possibly have the same design

and costings for each different idea. Once a firm decision is made on what the main technology, idea and story behind the installation is then it will be just a matter of following our nose to get it completed. I hope. Dexter 2:56 PM Mon 19/04/2004

[247] What I think I meant to say was that brainstorming (individually on our own ideas or as a group) on a definate topic/title within the concept of city, threshold could give us a clearer understanding of the ideas we want to portray. I could be wrong but isn't the given theme of city or threshold a broad concept to give us direction in devising an installation that falls within those ideas, not necessarily those exact concepts? Don't know if I'm making sense but thats what i was pondering over this morning! Jones 2:10 PM Mon 19/04/2004

[245] It seems a little pointless giving something a name when we don't even know what it's going to be about. Maybe we should make a firmer decision on Tuesday about the actual content of the installation and then derive a name from that. I suggest that Joseph collects all the main ideas spoken about in the discussion boards, and then on tuesday we vote on them. Whittle it down to two main ideas and then finally agree on the theme, topic and progress of the installation. Once we have a definite target it will be much easier to come up with design ideas, concepts and budgets, and also a name. Remember these are only SUGGESTIONS. Dexter 1:11 PM Mon 19/04/2004

[244] Following on from Henrik's comment that we should have a sense of humour about this installation, what we really need now is a name or a title regardless of what we actually do - theme is city, threshold etc so obviously should reflect that. so how about people post one word titles and we can pick one! Jones 12:12 PM Mon 19/04/2004

[243] Brainwave: We've got a beast of a sub-woofer, a big one, so big we should use it to scare people. So.. We get a taxidermified/stuffed baby chick, with a little sign that says 'pet me'. We attatch some sensors, and when they go to pet it, the sub-whoofer makes a 6hz at 500db chirp.. we should have a sense of humour for this installation thing. Henrik 1:37 AM Mon 19/04/2004

[242] After employing the software engineering principle of code reuse, I messed around with the web spider for extracting words with city content and edinburgh content. The spider downloads whole sites localy and then traverses through this site's links in a recursive manner. It will only download those where pemission from the server is granted. After this step, I use a Perl script to retreive only the text and get rid of the HTML tags. There are many issues involved that make it inefficient and this means that the final file I now have includes other words as well.... not only senteces with city :(I will need to speak to the sound team at some point for discussing on that. Also, rhetorical systems website only deals with a small amount of words each time. Is there a more feasible way to get round that ?? Aragon 4:33 PM Sun 18/04/2004

[240] sotiri, i am still interested in visiting the art gallery in glasgow. want to go for it? everyone else, sorry for showing up so late but i just got back from italy. i

think i will join the event group if Jones, Dan, Miro are ok with it. ciao! Francis 9:54 AM Sun 18/04/2004

[239] Henrik's idea is really cool. But are we going to have a perforance? Or make an installation to let the people coming in to experience and develop their own multimedia events? Kevin 1:24 AM Sun 18/04/2004

[238] We'll certainly be thinking about an inverse audio feedback experiment for Tuesday (right, Henrik?). Joseph, perhaps we could have a chat about this on Monday? Henrik's multimedia jam sounds great, I'm sure we can come up with a context (how about we have it //OUTSIDE if it's dry and /INSIDE if it's wet?!). Bob 8:8 PM Sat 17/04/2004

[237] sorry, it is 3:00 am on Sat morning, maybe i should go to bed. tara everyone... George 3:4 AM Sat 17/04/2004

[236] You propably thinking why i am checking the message board 3:00 am on Friday night. Well finished work and though of checking and my god, there are so many good ideas. I dont know if my idea will sound irrelevant, but will try to explain what i thoough. Right, we are doing an instalation that will project a threshod between domestic and public, inside and outside. Maybe, it would be cool to kind of divide the space (instalation room) to two different zones, an inside and outside, a domestic and an urban zone. The division could be obvious, the more visible, the stronger the threshold. Maybe this division could be glass wall or a door. Yvonne has taken some video of a galery's glassy window (with Miro behind it...) and thought of that division.... Anyway, this may sound complete nonsense...(i should make it clear, i had only 1 pint-i was working)..but thought it is worth mentioning it. This might be more interesting for my groupmates in the Spatial team.... Another thing, i noticed that Alexis arranged to come to Glasgow for the Glasgow Art Fair. I have said already that i am interested in visiting the Festival, it would be interesting to meet any person that comes to our vibrant city and after the fair, we can go for coffee... maybe see some of yous 2moro. bye, over and out. George 3:1 AM Sat 17/04/2004

[235] [MATERIAL FOR THRESHHOLD WALL] : Regarding this issue and as Dexter has mentioned previously, latex might be a bit expensive and sponge may be a cheaper one to use. Although different materials have different molecular structure which impinges to different propertoes. What I want to say is that it might be more difficult to sense areas on the wall if this is to be touched, with say.... sponge. Depending on how we want to do things, this problem can be eliminated.. I illustrate my point on materials here -------> Aragon http://ddm.caad.ed.ac.uk/~MMinopoulos/Installation/materials.htm 7:51 PM Fri 16/04/2004

[234] I lifted the idea of the possibility to code a web crawler to mine the intenet for text on the theme of the city and thresholds and what not. What it would do is 'crawl' (go from page to page following links) and compile sentences witch contain certain keywords like 'city' and 'threshold'. We would then have a huge

repository of sentences on the theme, these could then be used in some way, one could have them automaticaly spoken by speach software or be used in animations.. Coding this isn't too hard but it isn't peanuts either and would probably take me a fair bit of time, so I'll (or some other former computing student) only do it if we think we could make some use of it. I'm sure the crawler could come up with some pretty funny interesting stuff. So tell me if you think this is something worth investing some time into. Henrik 5:37 PM Fri 16/04/2004

[233] Had some ideas for a possible performance.. A good friend of mine has MIDI drum kit (a full size beast: kick,snare,three toms, two crash, ride, high hat), and I thought one could very much make use of it, and he is up for doing this. We could plug it into Jitter and have visual feedback to his actions (drumming with light: we could have each drum to, say, generate a blurb of a particular colour, rotate a model, alter a video... the intensity of the drumming is also a parameter, well the sky is the limit really.). Also we could make it sound like anything, doesn't have to sound like drums. We ought to make use of Bob's virtuoso keyboard skills, there is a big midi keyboard available from the music department. We should then throw in Dexter with his bass skills, and perhaps myself on the guitar, plugged into funny effects and we could then do a live improvised sound/light sculpture thing. Joseph aquired a bunch of floor sensors, which also plug into midi, which we could then place together and make a sort of responsive dance floor for audiance interaction. Each midi input (we now have loads of them) can trigger pretty much anything in jitter (&MSP), more over Dexter's bass and my guitar could also act as parameters, so I beleive that there is good potential here for a real funky trippy event. How to link it to theme is the question, maybe just have the visuals have some sort of city/thresholdy thing going. Any thoughts? Henrik 4:51 PM Fri 16/04/2004

[232] Kevin, sounds like a Disney movie. I like the idea of using the homeless guy in some way. The online log at the moment will be for the benefit of the class to enable all teams to create their log as they progress and also to share files, media etc. The external website on the other hand could reflect this. The homeless man could provide a story for the entrance to the exhibition, a journey that the old man undertakes to get to the installation, which could be played at the entrance to the installation. But I feel that the log should be used as a resource centre which can hold all related material..it doesn't have to have a theme at the moment. Dexter 3:31 PM Fri 16/04/2004

[230] To: Alexis and Debbie. I've got the plans from Joseph. He photocopied that for us. Thank you Joseph! Robert 3:14 PM Fri 16/04/2004

[229] Regarding Dexter's inverse audio idea, I have done this kind of thing before but with limited success. It can work but averaging audio levels is a difficult thing to do in a crowded room believe it or not -- we could make an experiment with this on Tuesday perhaps - MATT and HENRICK - you got time to think about this before then? by the way, they are using lycra downstairs in the

workshop - you should go and have a look at what they are doing. Maybe lycra is the answer, it is certainly much cheaper... Joseph 2:41 PM Fri 16/04/2004

[228] that is a good idea of Kevins. there could be a situation where we set up an inverse volume. If lots of people are in the gallery making lots of noise then the sound is low but when people are quiet the volume increases, it could be like the constant conflict in the street with traffic noise etc.. microphones detect the noise and then max msp plays something back that is inversely proportional to it..is this possible Bob or HENRIK Dexter 1:58 PM Fri 16/04/2004

[227] To Dan's idea, maybe we can use those short films to make a dynamic montage. Different short films would be played depends on the movements and the changes of voice of the performers. In that sense, it has an implication which bring the performer to different situations when he/she does different things. Kevin 1:33 PM Fri 16/04/2004

[226] I like Bobs idea. We could maybe explore it a little further. have something like //outside/inside where // indicates outside and / indicates inside, then we can do some very interesting stuff like certain gestures or interaction with the boundary causes a movement through a directory structure. A HAPTIC BROWSER, or use .. for outside and / for inside and that way browse through the web or directories that are represented by movies and images, going from outside to inside, as you get deeper in to the directory structure the movies and sounds become darker and represent inside and lighter repreenting outside in the opposite direction. Just an idea..phew !! Dexter 1:6 PM Fri 16/04/2004

[225] Hi all, just in terms of making movies for projection the BBC website has an intresting "thing" going. 1 minute movies. Perhaps each member of the class could make and submit a 1 min video and we could make a montage or something.... Dan http://www.bbc.co.uk/films/oneminutemovies/ 12:21 PM Fri 16/04/2004

[224] A thought I had about content: lots of the ideas yesterday seemed to involve the idea of being outside or inside (naturally enough, given the threshold theme) so maybe we could explore this with a working title based on something like: "outside/in/ - edinburgh04" or something. The forward slashes make clear our digital slant. Plus there's wordplay to be had (sounds like "outside in edinburgh" etc...). The space is well suited to exploring this kind of theme I think. But it's just a thought, we need lots more! Bob 11:18 AM Fri 16/04/2004

[223] found some information on pond rubber. should be easy to find a sample nearby. alexis http://www.pondtechnology.com/pages/epdm.html 10:19 AM Fri 16/04/2004

[222] I found this bed spread company who make bed sheets out of latex, maybe they can help too. Joseph http://www.betweenthesheets.co.uk/default.cfm/loadlevel.1/loadindex.15#Latex 10:11 AM Fri 16/04/2004

[221] I was just thinking and a possible source for the material for the wall/membrane could be a rubber balloon manufacturer in the uk, we could just but a long length of it from them !! Dexter 4:4 PM Thu 15/04/2004

[220] Anyone interested in going to the glasgow art festival (3 concession + bus ticket), meet in front of maltings main door on this saturday, 17th at 9:30 am. see you alexis http://www.glasgowartfair.com/mod_5/pages/ 3:46 PM Thu 15/04/2004

[216] Is there anyone interested in spatial installation team? Here is only one people in this group. Robert 5:19 PM Wed 14/04/2004

[214] Juan Zhang wants to join the Survey Team Juan Zhang 1:55 AM Wed 14/04/2004

[213] Hey hey, I figured I should probably go into the Interactive team, Im a decent programmer and I've worked with sensors and PLCs etc. Mel 6:9 PM Tue 13/04/2004

[212] Ronniechooses to join Simulation Team. Ronnie6:4 PM Tue 13/04/2004

[209] yan jun and Kelly are prefering to join the survey team. yan jun zhang and Kelly 4:55 PM Tue 13/04/2004

[184] Joseph, the flying text is a combination of code from a book called Flash Super Samurai and some I did myself and some from an example in flash kit. I can post some of the code if you want. Dexter http://www.amazon.com/exec/obidos/tg/detail/-/0201771446/002-5340886-7016066?v=glance 1:13 PM Mon 15/03/2004

[183] Dexter, these look cool - like the flying text - want to tell how you've done it... Joseph 9:4 AM Sat 13/03/2004

[181] Nixon wanted to know where I got the font for FREAK, so here is the url. I also will post some mockups to this page very soon for you all to view. Dexter http://www.misprintedtype.com/ 9:24 PM Wed 03/11/2004

[157] does anyone know if the site in the previous message is safe to enter? Nixon 9:28 AM Wed 03/03/2004

[156] just a test me www.worstcasescenarios.com 5:3 PM Tue 03/02/2004

[79] Audacity in the lab should do it - import mp3 then export selection as .wav it is free to download Joseph http://audacity.sourceforge.net/ 8:40 AM Mon 02/02/2004

[78] Anybody know of an MP3 to WAV converter on a Mac ? Aragon 9:38 PM Fri 02/01/2004

[56] Why does nobody use this? Nixon 11:24 AM Thu 15/01/2004

[54] Thursday's 11.00 am class will be a re-cap on ColdFusion. See you there. Nixon 9:21 AM Wed 14/01/2004

[50] Message board is back in action after a glitch. comments welcome ... Nixon 8:48 PM Wed 01/12/2004

[47] can anyone suggest a worthy website? Luke 9:33 PM Fri 01/10/2004

[36] No... just descovered it.... :-(Yvonne 1:0 PM Wed 01/09/2004

[34] My password for the DDM server worked Yvonne 12:43 PM Wed 01/09/2004

[33] By the way, John, my for the DDM server password is working now... Yvonne 12:42 PM Wed 01/09/2004

[32] You can insert html tags to format. RDC 11:55 AM Wed 01/09/2004

[26] Good job Nixon, look anyone can do it! Joseph 10:34 AM Wed 01/09/2004

[25] Welcome to the new DDM message board facility developed in ColdFusion. Feel free to contribute to this online discussion. Only the last message appears in this window. You can also add links. It is not yet secure. Anyone can add a message! Nixon Green 10:31 AM Wed 01/09/2004

10.3. FORUM ARCHIVE

The forum which emerged in week two has various compartments, each team has an individual compartment, and within that compartment there were—much like standard forums—compartments for uploading files, adding information to a calendar, and compartments for individual discussion 'topic's'. What follows here is by no means an exhaustive record of all the forum material, but of specific forums and topics that best reflect how the forum was used. Specifically it was appropriated for discussions which required more involvement[414] or where the authors don't want outside interruption.[415]

10.3.1. WIP(e) FORUMS > Survey Team > Topic: Statistic files uploaded

Posted by Survey team

Two files about climate change in Edinburgh and Scotland are uploaded. Posted @ 04-May-2004 09:56PM

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[414] See Appendix A.1, section 10.3.2 where video encoding and proportions are discussed by a group; or section 10.3.5 where the merit of some video footage is discussed.

[415] See Appendix A.1, section 10.3.4, where the authors want feedback, and get it in one compartment without interruptions.

.10.3.1.1 Replies

[1] Posted By Dexter-Well done, there's some really useable stuff here. Now does anybody have any suggestions on what we do with it or if they have a piece of software or code that we can plug it in to, to get some serious results. I am going to try to use the data in some way with either the sound re-arranger that Bob is developing on the flash rain generator I have developed. Posted @ 04-May-2004 11:00PM

10.3.2. WIP(e) FORUMS > Survey Team > Topic: Video Encoding

Posted by Luke

Hey Guys, nice effects. is it possible to encode some or all of your clips into MPEG-B? That would make them run a bit smoother with Jitter. Thx. Posted @ 17-May-2004 07:52PM

.10.3.2.1 Replies

[1] Posted by-MSc User all footages were encoded and resized into 4:3 proportion\014find them in .”..DZhang/Public/All footages" Posted @ 18-May-2004 12:23AM

[2] Posted By Luke-Great, thx a lot! Posted @ 18-May-2004 11:49AM

10.3.3. WIP(e) FORUMS > Survey Team > Topic: Some more footage

Posted by MSc User

Some more footage Wind Posted @ 17-May-2004 07:09PM

.10.3.3.1 Replies

[1] Posted By Luke- Re: Some more footage That's a keeper! Posted @ 17-May-2004 07:49PM

[2] Posted by MSc User-and more here; smoke(slow); smoke(heavey); smoke(light); Driping2; Driping1 Posted @ 17-May-2004 11:27PM

10.3.4. WIP(e) FORUMS > Survey Team > Topic: some footages

Posted by Juan&Kelly

some footages: Some footages by now, we are still trying, please give advice. samples: rain; dripping and meandering on wood surface; footage1; footage2; footage3; footage4; footage5; footage6; footage7; footage8; footage9 Posted @ 10-May-2004 09:48PM Reply message

.10.3.4.1 Replies

[1] Posted By Mel-that's great! :D I really like the ones were the drops are dripping on the surfaces. Good work :D Posted @ 11-May-2004 01:12AM

[2] Posted By Luke-Nice videos. We'll definitely use these. Do you have a place (someone's public folder) where i could pick up the quicktime files? Cheers, Posted @ 11-May-2004 08:37PM

[3] Posted By MSc User-u can find them in "footage" folder in DZhang's public folder Posted @ 12-May-2004 12:15AM

[4] Posted By B Dog-thx :) Posted @ 14-May-2004 11:02PM

10.3.5. WIP(e) FORUMS > Survey Team > Topic: Some weather effects

Posted By Juan&Kelly

We have worked out some weather effect by premiere.these are some samples,If u have any requirement of any kind of weather effect please let us know! http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/rain2.mov; http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/rain.mov; http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/snow2.mov; http://webdbdev.ucs.ed.ac.uk/ddm/2004/Radio%20Wip(E)/images/snow.mov Posted @ 08-May-2004 03:36AM

.10.3.5.1 Replies

[1] Posted By Mel-These weather samples are pretty nice, definately usable but it would be more interesting to get live footage like we talked about in the meeting. I know it's very hard to get snow like that though. So yeah, nice work. Posted @ 08-May-2004 01:28PM

[2] Posted By Aragon-Well done !! snow and rain in Flash look very interesting. Try filming some close up of pouring warter over a surface and the simulated steam for fog like Henrik said, and maybe a close up of a light bulb for sun,...., think of ideas that seem like weeather.. That's what we need most Well done again Posted @ 08-May-2004 02:10PM

[3] Posted By Luke-yup, water dripping, trickling and meandering on all types of surfaces. glass, brick, wood, gutter steel. you can have several 4 second clips with different amounts of liquid. the flash rain with the sound is very effective. very close shots could be quite useful. nice job so far. Posted @ 08-May-2004 09:08PM

[4] Posted By Kevin-hum... could you explain what are you going to do with the videos? I think we not only have to know the features of the videos you need, but also what those features would be used so that we can optimize them. Would you need those vidoes in solid background for extraction? Do we need to think of the camera angles which maybe suit for the situations you are going to composite with? You mentioned close-up. But why all close-up? I think we have to know about this before filmming or making the simulations. Just ask and we would prepare for you but please be clear. I think we are a bit lack of communication this is somehow. Posted @ 10-May-2004 01:17AM

10.3.6. WIP(e) FORUMS > Survey Team > Topic: Statistics

Posted by Aragon

Hi guys, the statistics you found are just plain paper numbers of weather data of days that have already pass, althought really cool !!! . What we need (i suppose) is real time data of weather data, so that we can do something with them in real time. Otherwise we will have the same data in rotation... I know it is not very easy to find such data, but try and if you ffind them contact me here on wipe (Interactive team) You might have to contact people by e-mail to get permission to have access to such data. Cheers, M. Posted @ 05-May-2004 02:24PM

10.3.7. WIP(e) FORUMS > Survey Team > Topic: More weather data

Posted by Kevin

I have found two websites that have some Edinburgh weather data archives. They include daily weather data of Edinburgh. I'm looking into the site and see if i can write some data parser to extract those data from them. By the way, I developed a snow genereator in flash with Max/Msp connectivity. We might use the sensors to gather real time data and send those to flash and do some snow simulation. Posted @ 06-May-2004 12:08PM

.10.3.7.1 Replies

[1] Posted By Kevin-Oops... I should post the links as well. Russian Weather Server; UK; Daily Weather Acrhive. Posted @ 06-May-2004 12:17PM

10.3.8. WIP(e) FORUMS > Survey Team > Topic: an other weather data(update every half hour)

Posted by Juan

http://www.wunderground.com/global/stations/03160.html. Posted @ 06-May-2004 02:16PM

.10.3.8.1 Replies

[1] Posted By Kevin-I'm thinking of making a cfml script to grap the data half an hour for this site. But I want to know how much data do you guys need. If just several piece of data on the web is useful, spending time on writing the script might a kind of wasting time. Posted @ 10-May-2004 12:36AM

10.3.9. WIP(e) FORUMS > Interactive Team > Topic: more footage

Posted By MSc User

please see Survey Team forum. Posted @ 17-May-2004 07:09PM

.10.3.9.1 Replies

[1] Posted By MSc User-all footages were encoded and resized into 4:3 proportion\014find them in .”..DZhang/Public/All footages" Posted @ 18-May-2004 12:23AM

10.3.10. WIP(e) FORUMS > Interactive Team > Topic: Working Logs

Posted by Joan

Hello, interactive team, I really like what you guys showed yesterday, very impressive! makes me want to learn more programming. We(online log team) are trying to record working progress of every team, will shoot videos, take photos, do interviews and so on.... I'm assigned to your team and hopefully will follow you for the next few weeks... it will be great to keep record of what you're doing now and sure it'll be a fun to look back after the installation.... anyway, if you have any meeting, any progress, any announcement, etc. please let me know, thank you very much! Thanks, Joan Posted @ 30-Apr-2004 12:36PM

.10.3.10.1 Replies

[1] Posted By Mel-OK, no problem, will do :) Posted @ 01-May-2004 01:25AM

[2] Posted By Luke-Hi Joan, I don't know if you'll check this soon enough, but we're having a meeting at 3 pm today (Wednesday the 5th) in the studio. Posted @ 05-May-2004 12:51PM

10.3.11. WIP(e) FORUMS > Interactive Team > Topic: Flash to Quicktime

Posted by Luke

Hi Aragon, I was wondering how you managed to convert your flash to quicktime (the sun and the rain). I know how to do it (Publish Setup) but i keep getting a message that the proper hardware's not installed. Did you have any problems, or is it just my account. and by hardware i mean software. anyone else have this. problem? Posted @ 05-May-2004 12:59PM

.10.3.11.1 Replies

[1] Posted By Aragon-Hi Luke, left prety early yesterday. If you go to File>Export Movie amd then from that select QuickTIme Video. This should do it, at least worked for me :) Oh, something else, we agreed with Henrik to buy black lights and Blacklight paint to use with the umbrellas. If you happen to know any shop or website that might be selling this then tell me. Aragon. Posted @ 05-May-2004 01:52PM

10.3.12. WIP(e) FORUMS > Online log team > Topic: Playing with maya particle system

Posted by Luke

Hello, here is a lightning effect that i made in maya for fun, if you want to use for the installation, feel free. Cheers. ParticleExercise.qt Posted @ 16-May-2004 08:40PM

.10.3.12.1 Replies

[1] Posted By Luke-There is another lightning effect clip: another clip Light.qt. Posted @ 16-May-2004 11:54PM

[2] Posted by Luke-Thanks Luke, I think these may come in handy :P Posted @ 17-May-2004 07:41PM

10.3.13. WIP(e) FORUMS > Online log team > Topic: Weather Symbols

Posted By Dexter

I noticed that everyone seems to be concentrating on the physical conditions of weather but here are lots of way weather is measured from thermometers, barometers, anonometers and symbols.. Maybe we could develop something interesting with these.
http://ww2010.atmos.uiuc.edu/(Gh)/guides/maps/sfcobs/home.rxml Posted @ 02-May-2004 01:28PM

.10.3.13.1 Replies

[1] Posted By Joan-yeah, that's a good idea, I like those symbols, they are kinda mysterious for me. Because fascinated by the interface of Max/MSP, I made this http://ddm.caad.ed.ac.uk/~CWang/radio/radio.html yesterday, though it's PD instead of Max coz I don't have Max in my laptop Posted @ 03-May-2004 10:53AM

[2] Posted By Dexter-That;s a nice idea Joan, you should take a look at what ALAN did for his resource collection presentation and maybe try to incorporate that in something on the website. Also I have attached a quick idea for the look of the website also. new_idea_sput.jpg Posted @ 03-May-2004 12:42PM

10.4. FOCUS GROUP

The purpose of this focus-group is to glean insight into the discourse and participation of the group involved in the execution of this Installation; how computing devices which were readily available were used; and where the devices enhanced or became problematic during the discourse. The group of approximately thirty students, while all the time being monitored by the course organisers, negotiated the direction and content for this installation using a combination of face to face meetings, mobile phone and the two types of messaging device described above, the message board, designed for consecutive posting, and the forum, subdivided into 'topic' compartments allowing for specific posting to specific topic's.

What follows is a transcript from a recording of a focus group with three students who were key participants in the project and its discourse. While transcribing the focus group and reflecting upon it, the author has periodically added an *[authors note]* related to the material being discussed.

[01:15] Author: How did the idea for the installation come about for changED?

[01:25] Luke: The idea of weather was only decided halfway through the 6 week program, which involved longer discussions with the whole class.

[01:50] Aragon: In time the [deadline] became more and more tight and we were rejecting some things.

[02:30] Author: What was the reason that certain things were getting pushed to the side?

[02:40] Aragon: More people liked one idea than the other. Because we were so many we had to have some coordination. All the time Joseph was playing the role of the supervisor. He was trying to push us to tell something that we really like. We discussed many things like erosion, eventually it became more specific to change and weather change.

[03:25] Author: Were there other ideas?

[04:00] Aragon: The original idea was 'threshold' and we were going to split the room in two... but when we had the theme it was easier, when we knew it was not threshold but weather.

[04:01] Luke: ... a general city 'thing'. Two weeks before [the deadline] we still didn't have the final configuration, we had to vote on what people wanted. There were some groups like the spatial team who thought there job was to do what we were voting on. They had spent time modeling the space, analysing it and coming up with ideas.

[authors note] The need to vote could indicate that the messaging system does not afford the gathering of a concensus of opinion, in this instance it does not seem to have helped the decision making process, at least not without support from other means, ie face to face real-time discussion.

[06:30] Bruce: There were many proposals for the space, but I think some of them were not thought out, not suitable for the space.

[07:15] This was your message board [on screen], were you using it to put up ideas?

[07:25]Luke: This is like the main one that I would use. We were encouraged to put up a hundred words for an idea for the installation.

[07:50] Author: After everyone had posted their ideas, did certain themes start to emerge?

[08:15] Luke: All the themes were discussed in class so there was nothing way out there, everything was related. Everyone had their own idea of what they wanted the installation to look like.

[authors note] Class discussion seemed to mark the edges or boundaries for the discourse surrounding the generation of ideas.

[08:55] Aragon: Some of the ideas were [technically, financially] very difficult.

[09:15] Author: Did it come down to having to meet and make the decisions or were final decisions left with Joseph?

[09:35] Luke: There were some ideas that caught on. The idea with the umbrella, that was Henrik's idea. That happened at two in the morning and we had this thing were we would post wacky ideas on the message board. There was one that completely flopped earlier that was about scaring people with a sub-woofer. People started to come and say they liked the idea and it eventually has become sort of an icon for the whole thing.

Interesting, while the class discussion set boundaries the idea, and subsequent 'icon' for changED came from a random idea, a moment which was captured on the message board and displayed for others to see.

[11:10] So then you had the Forum RadioWIPe website up and running. Did people take to that sub-divided topic system immediately?

[11:20] Luke: This one was much nicer, because you could talk to specific groups of people within your group. You could upload things. Checkout what other teams were working on. So groups were carrying out their discussion in public so to speak.

[11:40] Aragon: I think the first week it was up people were still posting messages to the message board because they were familiar with it. It [RadioWIPe] had a calendar which I didn't use at all. I mean it was a bit silly when we were in here every day seeing each other. What would have been useful which wasn't there was peoples e-mails.

[11:20] Bruce: We had to keep telling people to use the site.

[authors note] It was easier to arrange something on the spot rather than post a suggestion and negotiate when and were. So the calendars became underutilised.

[16:45] How easy was it to find things on it?

[16:50] Luke: Pretty easy, I mean there is not all that many topic's. It was great because we were doing the big screen stuff and the team that was doing the video's we didn't even meet them once. we could ask them to do it in this format or compress it like that and they would do it and upload it.

[authors note] So RadioWIPe was good for 'telling' and 'instructing' but not necessarily for obtaining consensus or agreement.

[18:10] Bruce: Some people would not use the upload section but use their own web-page and post a link.

[20:10] Luke: Because there were topic's you could check back, the other message board was just sequential, people get interrupted.

[authors note] The word interrupted is used again later in the same context.

[19:00] Did you do much e-mail during the preparation for this installation?

[19:05] Luke: No, but its the best way of making sure they get it.

[19:15] Aragon: Mostly for deciding on the domain name.

[authors note] Seemed to prefer the security of 'sending' an e-mail rather than 'posting' to a message board. Sending, is a positive action, where as posting to a message board might be seen as passive.

[19:50] Was it useful having all this discussion in public, for all to see rather than it being all e-mail?

[20:55] Luke: Yea, its good to see what is going on and what's being posted even if its not directed at me. You could go to the different groups and get an overall idea of what is going on.

[authors note] Was the over all pictured, garnered from access to the entire forum of conversation, helping the individual groups with their specific contribution?

[22:00] Is there anything which could have been done which might have improved the forum?

[20:30] Aragon: There was a bit of a problem with the privatisation within the groups. It was difficult to post something that everyone could see, if for example Luke was in my group and I wanted to post something for him, it would be extra effort for me to them post it to everyone.

[authors note] The 'general' was given the same grouping priority as all the other groupings.

[24:20] Would it have been beneficial if general messages appeared on each individual message board?

[24:45] Luke: No, if you wanted to look at the general messages you just go to the general messages, I don't want... well I guess its all right... if you have topic's I guess it doesn't matter as you wouldn't be interrupting. It might be good it you could choose which groups it goes to.

[24:40] Aragon: Hmm, maybe

11. APPENDIX A-2: INTERVIEWS

11.1. QUESTIONNAIRE

11.1.1. Company Context

The following is a short summary of a company to accompany the questionnaires.

Questions to ask

How and when did the company begin?

What way is the company Structured?

What are the advantages of this type of management structure?

What is the companies' presence on a job site? (no direct labour)

Does the companies insurance cover subs?

Main contractor and Sub-contractors on site... anyone else?

What tasks within or periods of projects are most critical?

What types of technology/computing are you already using?

CAD; E-MAIL; WORD PROCESSING; PEN & PAPER; TIME MANAGEMENT (REBUS ETC.); ACOUNTANCY (SAGE ETC.); OTHERS

Company Name:

Structure:

Employee No.:

Contract Size:

History:

11.1.2. About Interviewee

Name:

Position:

About:

Out of the day, how much time is spent dealing with problems on site?

How many hours/minutes each day is spent:

Using a mobile phone

Using a Landline

Using e-mail

Just chatting

Attending formal meetings

11.1.3. Mobile Phones

1. How many years have you had a mobile phone for work?

1(a). Why did you get a mobile phone for work? (realised it would be valuable or felt it was necessary because others were using them)

2(a). What features does your phone have?

Options: SMS; MMS; Phonebook; Internet / WAP; Calendar; Alarm Clock; Notepad;Other

2(b). What features on a mobile phone do you use?

Options: SMS; MMS; Phonebook; Internet / WAP; Calendar; Alarm Clock; Notepad; Other

3(a). How many calls would you make in a day?

3(b). How many txt's would you send in a day? Why txt and not call?

4. Do you get distracted from what you are doing when you make a call?

5. Do you make calls on your mobile phone because: grade these 1 – 6 (1 being most often and 6 being least often)

Options: Urgent; No landline available; Checking In; Unnecessarily; Need information; Other (please state)

6. If you make a call on a mobile to obtain information how often do you get an answer? grade these 1 – 4 (1 being most often and 4 being least often)

Options: On the spot; Within the hour; Within the day; Within the week

7(a). How many calls would you receive on a mobile phone during a day?

7(b). How many txt's would you receive in a day? Do you think there is a difference in what people are calling for and what they are txting for?

8. Do you get distracted from what you are doing when you receive a call?

9. Do you receive calls because: grade these 1 – 6 (1 being most often and 6 being least often)

Options: Urgent; No landline available; Checking In; Unnecessarily; Need information; Other

10. If you receive a call on a mobile to obtain information how often can you give an answer? grade these 1 – 4 (1 being most often and 5 being least often)

Options: On the spot; Within the hour; Within the day;' Within the week

11. Do calls usually include friendly / small talk ("how's the family? Did you see the snooker last night?" etc.)?

12. Do you do that?

13. Do you find others do it when they call you?

14. Are there particular times when a mobile phone is an annoyance?

15. Are there particular times when you find it particularly useful?

16. Would you say you use it to ‘fire fight’?

17. Would you say other call you on a mobile phone to ‘fire fight?’

18. Do you ever turn it off? Are there calls you would not answer?

19(a). How have mobile phones benefited your firm?

19(a). How have mobile phones negatively impacted your firm?

11.2. INTERVIEW 1: CONSTRUCTION ORGANISATION DIRECTOR

E McKenna 11:00 23.5.05 Director GEDA Construction Ltd

Arranging to meet Eugene McKenna one of the two Directors of GEDA construction was conducted mainly by phone, mainly by mobile. He did have on occassion bad reception or was in a meeting. In our last phone call to confirm our Monday meeting Eugene said-when prompted to agree a time "well, Dermott I sort of work that I've things to do on Monday but... you know... I don't make any hard or fast plans, there’s nothing that can't be moved around so whenever’s good for you." I agreed 11:00 am.

11.2.1. Company Context

The Company (GEDA) began in 1982, like most large construction organisations they are engaged predominantly in management construction projects. Originall;y a civil engineering firm, in the early 1990’s they moved into speculative housing which they now concentrate on. GEDA directly employ approx 45 people.

Approx 15 Engineers (5 of which are site managers)

15 Direct labour (drivers, scaffolding specialists, direct labour)

2-3 Marketing & Sales

3 Quantity Surveyors

3 Accountants

1 Systems Manager

1 Health and Safety Officer

They employ mainly professional people, which they consider more flexible than machinery... which, according to the interviewee “can only do what its designed to do.” With regards to staff training, GEDA regularly organise and circulate to enployees training programs related to time management (one next week at time of writing), marketing courses, finance courses etc. Their presence on site is limited to the allocation of a site manager to a project, usually this is a graduate engineer however on larger more complex projects a more experienced site manager and graduate engineer will be allocated.

Technology usage: CAD, e-mail, word processing, pen paper, accountancy (axim), cost control, Project Management software, monthly costing software for cost control. The company has also been accredited with ISO 9001 and 14001 with ongoing improvements and yearly audits as standard. For a lot of the jobs they tender for ISO accreditation is a prerequisite. Without it and without a quality assurance strategy they would not be eligible to tender for a substantial percentage of their

projects. Their annual turnover 10-12 million, and their main asset is plant, including cranes and teleporters.

For insurance purposes each sub-contractor must carry their own individual insurance. For quality control GEDA maintain an approved list of sub-contractors, as well as a proven track record of competence, these sub-contractors will have to have passed information of their tax status and insurance to GEDA, and they must complete a quality and environmental questionnaire.[416] This is required documentation that must be completed to ensure they 'fit in' with GEDA ISO strategy. Occasionally GEDA will take on a sub-contractor who is not on the list and they will also cover the sub-contractors insurance, there is obviously additional risk to GEDA taking this particular route, however if there are benefits[417] they will do so. The Director was clear to point out that if a site is ran properly, risks are minimised anyway.

The key date in terms of a project for GEDA is the hand over date, when a client or family will take possession of their new house. When a client agree a purchace of one or more houses they are issued a buyers pack which includes critical dates which buyer, lawyer and GEDA should meet to ensure handover in 8 weeks. GEDA build in a certain amount of flexibility for the buyer, and include critical dates where they should have picked their choice of bathroom or kitchen suite, or floor covering which fits into the Schedule of Work for the build. Similarly buyers lawyers must meet certain deadlines with legal documents and money transfer and GEDA also need to prepare and deliver not only the house by the agreed date but also various documentation and approval documents as well.

The company has 18 company mobile phones with a bill of approx £1000 a month. They have league tables of usage which they circulate to show each phone and user, and how much they are using their mobile phone.

11.2.2. Interviewee

E Mc Kenna (Director)

11.2.3. Mobile Usage

Q.1. 8 - 10 years

Q.1a To contact people

Switched of in office in evening. Recently the phone has been left on in the evenings because of a break-in at one of the sites, a security system will notify the interviewee by phone if it is triggered. With the phone switched off certain people stopped calling or did not leave messages (estate agents etc.) important callers would leave a message which he could respond to or deal with. He has noticed that with his phone being left on recently people who had ceased calling have now started again.

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[416] This is to show that they too have quality control systems in place and that they are aware of—and are taking steps to address—the environmental impact of the materials they work with.

[417] Benefits could be a number of reasons, for example the limited availability of approved sub-contractors or the need for a particular specialisation would prompt this course of action.

Q.2a/b Not overly concerned about the features of the phone (which sitting on the table was a rather distressed scuffed and battered nokia phone). He used SMS and phone facility.

Q.3a £40 pounds monthly bill about 10 calls a day, no outgoing SMS they are only incoming and personal. He does not consider them appropriate for business.

Q.4 Yes, even hands free distracts missing exits on motorway

Q.5. No landline. urgent 1; need info 2; Check in 3; Unnecessarily 6

6. On the spot 1; Within the hour 2; Within the day 2; Within the week 4. The interviewee usually rings the office for information so usually his call will be return called within hour.

7(a) less than 10.

7(b) 0.

8. Yes (see answer 4). Also on site when he's discussing a matter with graduate engineers, if the phone rings its—quote "almost a nervous reflex" to answer it. An instance was also referred to (not on a GEDA project) where an employee was called while on a roof and lost his footing, fell 30 feet onto concrete and lost his life.

9. Need info 1; No landline 2; Urgent 3; n/a; n/a

10. On the spot 1; Within the hour 2; Within the day 2; Within the week 4.

11 In reference to call length, when the interviewee makes calls he tries to limit them to 30 seconds as he get a headache. He gets straight to the point with minimal or no small talk.

12 No.

13. People get to know his mannerisms and get straight to the point, "I don't hide my impatience with people well."

14. In office and at home. He believes people will use the mobile phone first, he acknowledges he does this himself when wanting to make contact.

15. For fire-fighting[418] as you have the ability to sort problems out immediately.

16. Not often, on occasion.

17. Not often called regarding fire-fighting, as a Director he is out of the immediate 'loop' of a project. If he is called he will redirect the call to whoever is responsible for that particular issue.

18. Always answers it.

19(a) Everyone is contactable, one site in particular has a bad mobile phone reception but landline/fax/computer link is standard on all GEDA sites.

[418] A term used that suggests the last minute dealing with a problem that arose because of poor prior planning.

19(b) The ability for contact, calling site managers on site is distracting, if they are out of the office chances are they are dealing with something more important. They also cover up for poor planning someone can sort something out now rather than yesterday. It disrupts thought, but a good site manger can handle a site and a mobile phone properly... prioritising tasks, "site manager should have two A4 pages of 'to do' tasks... he'll never get through them all but by lunchtime you want to be thinking about what you need to order get ready for tomorrow. After all everyone thinks they are the most important at that time when they contact you, the site manager has to be thinking ahead, thinking about tomorrow."

Distractions are mainly administration or marketing and sales contacting site for facts or figures, details which site manager must return to site office for, so contacting him on his mobile is just potentially distracting him from what he is doing. Graduates jump for the phone when it rings.

Purac are talking about banning phones because they are a health hazard after accident. If your not allowed to use a mobile when your driving a car you shouldn't be allowed to when your driving a crane or a digger either should you?

We moved into discussing house design.

GEDA have half a dozen set layouts that work, the interviewee said they know what works, what people want and how many en-suites you need to a house. They don't use architects they will tell their in-house architect/draughtsman what they want and get them to draw it up. They may uses outside architects occasionally if they require something special.

Dormer windows add approximately £1000 of cost to a house, now sometimes you need them but you have to use them sparingly, they also create a gap in the trades[419] ideally you want one visit form a trade and then they move on. "we try and avoid gaps in trades." The plasters might accidentally break a few rood tiles or stain them with plaster and then when the roofers return they're complaining that it has to be cleaned or repaired and its not their responsibility, if we can avoid that we will.

Also to avoid gaps they give buyers a buyers pack... with critical dates for choice of kitchen, bathroom etc. The estate agent is only a skeleton service, they are the contact point with the buyers as they have high street office with good visibility. Also they occasionally inform you of a potential site becoming available. In terms of actually selling houses estate agents are terrible which is why we do most of it in-house after the initial contact by estate agents. Also if a particular site is not selling GEDA can cut back on production, build less and concentrate on a site which is selling.

11.3. INTERVIEW 2: SITE MANAGER

Cyril Ronaghan 12:30 23.5.05 Site Manager GEDA Construction Ltd

[419] Roof one bit and get in plaster to plaster dormer window, then get roofers back in then plasterers to finish dormer and then roofers again. This co-ordination is up to the site manager who moves the sub-contractors round the site or sites keeping them busy.

Cyril was called at the end of my meeting with Eugene, Eugene asked him if he could spare a few labourers and to keep his eye open as they needed one or two on another site. Second I was there and he wondered of he was busy and could I come down to the site. "When's good for you?." I had a meeting with Cyril in 30 minutes.

11.3.1. Interviewee

C. Ronaghan, Site Manager, GEDA Construction

The interviewee is based on a site outside of a small town in Northern Ireland. The project is a speculative housing development, approx 70% of the site where the interviewee is based does not allow for a mobile signal.

11.3.2. Mobile Usage

1. 3 years

1(a). He had been using his own mobile phone and it was costing him money until he was eventually issued a company phone.

2(a) and (b). Phone, alarm (to wake him up), SMS.

3(a). Less than 5.

3(b). 2-3 personal, Cyril would phone if it was urgent and text if he didn't require a answer right away.

4. On site Cyril will—as he is walking round—make notes on a note pad and when he gets back to the site office call or fax requests rather than calling on the spot on site. He uses this method to try and avoid making calls on his mobile when he is out on the site. This adopted method is as a result of management training courses encouraged by GEDA and by being tutored by senior management.

5. No landline1; Urgent 2; Need info 3; Checking in 5; Unnecessarily 6

Due to the bad reception on site when Cyril leaves site and picks up a signal his phone starts to receive messages, so most of his calls are call backs to people who have initially called him.

6.Question not so applicable as most of his calls are call backs. But usually Cyril plans his day so that an answer within a day is sufficient.

7(a). 4-5 calls (of which some he would have to call back immediately) don't usually need an answer immediately.

7(b). 6-7 SMS.

8. Yes

9. Need info 1; No landline 2; Urgent 3; n/a; n/a.

10. Within a day.

11. Usually a little small talk, calls last 1-2 minutes making and receiving.

12. Yes.

13. Yes.

14. Not in this job because mostly there is no signal.

15. When he's not on site, although he said he is only ever of site for 15-30 minutes at a time and only 1-2 times a week. He winds up calling sub-contractors at home because they are either not available on the phone during the day or he cannot reach them because of the poor signal.

16. Not often, on occasion.

17. Sometimes, most calls received are from head office or sub-con's most are from head office admin and organisational related (plant, labour). Some which he finds disruptive are from the Marketing department and are questions regarding materials, marketing deadline dates. These calls he avoids answering if he can as they will eventually obtain the information elsewhere. Gets calls from other local sites asking if he can spare certain workers (labourers, joiners etc.), and he will do the same if people have not turned up to work and it is affecting progress.

18. Might turn it off in a meeting; there might be personal calls he would not answer.

19(a). Contactable. Calls sub-contractors at night maybe 3-4 calls a week and they would last a bit longer than normal perhaps 3-4 minutes. Checking on progress, asking for requests (materials or information) or confirming attendance on site at a specific future date to maintain the construction schedule.

19(b). The ability to contact. Doesn't negatively impact the job but perhaps too contactable. For example at 10:00 - 10:20 and 1:00-1:20 he might receive calls in the hut (site office) because people know they will be in there at teatime. Concerns about distracting site workers around machinery or when they are guiding cranes or heavy loads receiving and try to answer mobile phone calls.[420] 80-90% of the people on site have a mobile phone and they constantly have to check staff and remind them not to use them. Mostly usage is SMS, people will stand with head down for a couple of minutes and send an SMS message.

11.4. INTERVIEW 3: SITE MANAGER

Gerald McKenna (N/A)

11.5. INTERVIEW 4: SUB-CONTRACTOR

Sean Farrell 2:30 25.05.05 Director Farrell Joinery

11.5.1. Company Context

Farrell Joinery has been operating for 4 years. Previously the interviewee was a director at Woodlock Joinery were he had been employed for 25-30 years. When the company made a corporate decision to stop making wooden stairs the interviewee left Woodlock and started this company specialising in wooden staircases. In the four

[420] Another case cited by an employee where a worker who was guiding a crane of reinforcing mesh holding the mesh with both hands took one of to answer his phone. While this did not cause an accident, it illustrates the reflex action of answering mobile phones.

years since they started—I am assured—they have created enough stair to reach the summit of Mount Everest. Sean personally visits and measures every site, does every quote (of which they secure approx 1/3). They also do some specialist woodturning but by far the majority of their work is stairs.

Marketing

Farrell Joinery can be found at trade shows but virtually all the quotes Sean makes are from people who have heard about the company by word of mouth, or they have seem stairs in a house and made contact based on that. They don't advertise, until recently they had a single A4 double sided sheet with some samples of their work and contact details. Recently they have invested in glossy folders which they use to send out quotes and samples to clients.

11.5.2. Interviewee

Sean Farrell, Director, Farrell Joinery.

Our meeting was held in the interviewees' office. Sean was out of the office yesterday, when he returns he returns to paperwork. Our meeting had been scheduled for the afternoon to give him time to get through it. When I telephoned on the morning of the interview to confirm a time Sean was still "wading through it." But assured me he would make time for me. We met at 2:30. Sean is passionate about his work, and about wood and our interview took many turns.

Sean has a small office, with a window facing the approach to the office, which is a Porta-cabin outside his workshop; he is the first person I could see as I approached. Sean prices virtually all quotes with some exceptions, "you eventually get to know the people who are only comparing prices and are not giving you work, and you stop pricing those jobs." Last year they invested in a CNC (Computerised Numerical Control) machine which has dramatically increased their turnover and decreased man-hours per stair.

The Quote

The interviewee visits each client and notes "to me these are just another set of stairs but to them its the most important thing in the world to them at that time, so it has to be the most important thing in the world to me... do you understand what I'm saying?."

Seam produces a single A4 sheet with a simple line drawing of the stair plan, critical dimensions and some standard information (wood type, open or closed threads, half risers, banister balustrade specification etc.). This drawing is priced and sent out. When the order is secured according to the interviewee then the talking starts, "people don't know what they want... well they do but they don't… if you know what I mean? They have to be guided and told. What they want might not be right, you have to start working with them and chopping and changing until its something their happy with and I'm happy with."

The System

In the interviewees office, he shows me a rack on the wall with orders arranged like time cards for punching, there are three columns for different stages of work. "I've let this system slip, instead what I now use is this..." A stapled bunch of A4 sheets, every job and quote is on it, and its current stage. If the company completes an order he highlights it, if he does a quote he writes it in. These sheets are passed to administration weekly and revised.

The Drawing

With everything finalised the drawing is passed to an administrator who doubles as a computer operator who draws it into computer using the CNC software. The software produces a cutting list, a list of all the pieces of wood which will be cut using the CNC machine and lines indicating not only every single cut the machine will make but also the approach trajectory and exit trajectory of the bit (which rotates at 2400 rpm and is automatically selected depending on the type of cut). This cutting list is copied onto a 3.5 inch floppy disc and carried out to the workshop approximately 25 meters away, where it is inserted into the CNC machine.

The Workshop

The workshop is three buildings two purpose built and one a converted cowshed. The newest of the purpose built buildings houses the CNC machine and wood storage. At the time of the interview it also has a large rack on the floor which was being used to laminate curved runners for a complex set of stairs. It will also be used for preliminary assembly. The second building is a more traditional workshop, with traditional tools such as planes, braces, wood chisels and lathes to manipulate wood that does not require CNC machining, and finally the third building is for assembly of stairs and their components.

The Cutting

When the floppy disc reaches the CNC machine it is checked by the operator, a young man was operating the machine today "we had someone not turn in this morning and Paul here has been thrown in at the deep end.” Paul was looking at a cutting list, Sean uses it to illustrate the limitations of the software and people. For example the software cannot handle a half landing with two upper runs leading of it, nor can it handle two runners (the long sections of wood up each side of a staircase), the operator and the interviewee decide what pieces on the cutting list they will and will not cut, and what they must cut twice... due to limitations of the software previously mentioned. There are also limitations in people, “Gail's great at what she does but she doesn't know stairs, sometime when the cutting list comes out to the floor the man on the CNC will look at it and bring it straight back into the office. Now I now men working on these machines not to far away from here and they are sending the cutting list across wires to the CNC and the operator only has to push a button, in fact he's been told you just cut whatever comes out of the office. And then you end up with a pile of shit coming out of the CNC... do you understand what I'm saying? The drawings are useful for spotting problems, but that requires expertise, and there are still limitations in the software. The cheapest place to reject something is in here (pointing to the cutting list which is on screen on the CNC machine), you

reject it of the machine it might cost you £40, you install it (in someones house) and £40 won't take it out again."

In some instances Farrell Joinery are only making specific difficult components[421] for another stair manufacturer who are not capable to manufacturer them.

The CNC Machine

The CNC machine is not dissimilar to what the author would recognise as the first generation of CAD plotting machines, the 'bed' of the machine is a fixed surface, the wood is prepared if necessary and held in place on the machine bed (in this case by suction). The CNC moves over it with a selected bit and cuts to the required depth, if necessary it will change bit and continue cutting, each piece of wood is individually cut and then the machine moves onto the next piece. The machine produces more waste than traditional methods.

The Wood

Storage is the main issue for Sean, he has to store a vast amount of timber, both locally cut and imported, 'system' timber of which "every piece you can use." He showed me piles of rough cut timber, some of which was unusable as it was bowed, split and twisted, but it was cheaper that the system timber. Every piece of the system timber which is made up of small pieces of timber laminated together, is perfect and all can be used, but slightly more expensive. Moisture content (MC) of the wood is critical and so storage becomes critical (particularly in the UK and Ireland) so that the MC does not compromise the timber.

The interviewee gave me a brief education on wood, its type and what the grain can tell you about a piece of wood. He was recently on a trip to Germany to meet with a prospective supplier. A certain amount of the wood which was delivered from this supplier was un-usable, a large pile was set aside in the workshop because it was being sent back because it was virtually all unusable. The interviewee was quick to reprimand the suppliers representative telling him "I was making stairs before you were born... don't try and tell me what good quality wood this is." The rep was keen to look at the wood and said he would arrange to meet and look at it. The interviewee was quick to reply that there was no need, the wood was going back to the suppliers yard whether he came or not and the representative would be able to inspect it there.

Fitting

Farrell Joinery uses self employed fitter, he pays an hourly rate to them. He does not fit all the stairs he produces "We couldn't."[422] On occasion there is a loose fitting balustrade but if Seans measurements are correct they will fit. He shows me a critical dimension on a drawing, in this particular case the dimension is to the edge of a newel post. While this is a subtle differentiation to say the dimension being to the centre of the newel post, in this instant the clients want a fully exposed Newel and

[421] For example this could be a particularly complicated newel post or handrail detail.

[422] This is in reference to the quantity of staircases they produce. They would not be able with the number of staff employed to fit all of them.

not a recessed one... so this small differentiation is absolutely critical. I do get calls for the fitters, a few weeks ago I got a call where the stairs weren't fitting as they should because the builder had move a wall to fit a door in. I went and had a look and with a few changes it would fit. I wouldn't have just put the stairs in you know… I had to make them look right. And call the builder just to let him know that these wee changes cause problems.

As we were discussing this in the assembly building Sean pointed out a 'goat's horn' a complex piece of woodwork, which is an intricate finish to an elaborate handrail they are manufacturing. This is a days work to a man, its a set component on the CNC machine, just put a block of wood on it and a few minutes later you have a perfect goats horn. Sean grabs the attention of one of the workers who is boring a hole in a bull-nosed staircase step, "is that inch and a half or inch and a quarter?" referring to the size of drill bit the joiner is using, "inch and a half" was the reply, Sean turns over the goats horn "because that is inch and a quarter..." Whispering to me Sean says this is all on the drawings, its usually standard inch and a half . "Aye, but this man asked for inch and a quarter special... how far are you down?" about an inch was the reply, "finish it in inch and a quarter and leave it at that" the interviewee says and leaves it at that. "So you have limitations of the machine but you see you also have people who don't read drawings... all that information was on the drawing"

11.5.3. Mobile Usage

Sean turns his phone of at 6:00pm, he had left it with the Secretary next door because he was attending to me, I had also left mine at home to attend to the interview.

He has recently stopped using it on the workshop floor, they have a tannoy[423] system, which has also become obsolete. "If I'm on the floor its not to wander round and have a break I'm probably attending to something a dam side more important than a phone call." They have a duplicate book where all messages are logged and a copy left on the interviewees' desk, so when he returns to the office he can deal with those systematically, the other copy remains with the administration.

The interviewee uses his mobile phone in the car using a 'hands free' device. "Yesterday for example someone told me we were running low on nails (when he was in the workshop), I forgot until I was in the car and phoned Gail to order them and here (Sean holds up an invoice) is the docket confirming the order."

Customers will phone on his mobile rather than on the office number, but sometimes (like today) Sean will leave it in the office with administration for them to answer if it rings.

I've had people call the girls (in administration) and give serious abuse to them, and I know where they are coming from, you call a persons mobile its to talk to them, you don't expect to get someone else, then they come on to the phone to me and they're as nice as pie… What's important is that you call them back that builds their confidence that if they leave a message they know you will get back to them. If they have a problem they want through to the problem solver… If you want to know

[423] Loudspeaker system.

about mobile phones I had to fire a boy for using his mobile phone, he was doing nothing between txting and getting calls.

He said he doesn't get called during the day but Sean confiscated the phone and by the end of the day there were 20 missed calls. He's worked with companies where none of the senior staff use mobile phones, they can't be reached on them. On a site there might not be a landline, “but you'd never get any work done of you were answering it all the time.” The interviewee gets most calls over lunch when people know he's in the office.

11.6. INTERVIEW 5: SUB-CONTRACTOR

Eammon Coulter 23:30 26.05.05 Self-Employed mobile phone Node Installer. This interview—while not directly related to the subject of this thesis—sheds some light on more clandestine practices revolving round mobile phone usage circumventing the law. Eammon is from a rural region in Northern Ireland, he, like a lot of people in the area make his living from driving.[424] Eammon installs and maintains mobile phone nodes for a large catchments area. One of the clear benefits which has arisen from the widespread use of mobile phones in this area, is for the subversion of dippers.[425]

The use of agricultural diesel for none agricultural purposes is prolific in rural areas and especially in the border regions where until recently a loophole in the law[426] allowed agricultural diesel from the south of Ireland to be use in non-agricultural vehicles in the North.

To combat this the Police Service of Northern Ireland (PSNI) deploy teams which set up temporary random checkpoints to 'dip' fuel tanks of vehicles to check if they are using agricultural diesel. Eammon assures me

> the minute one person is stopped, the whole country knows. Lets say you seen dippers or were stopped and dipped, you might call or text me, I would call the likes of John and Finn and before long the whole country will know. You just lie low or avoid that area… there are people who wouldn’t be able to do their job without them… they couldn’t afford to run their trucks on clear (diesel)… you know.

Fionnula, Eamon wife had another instance where a mobile allowed subversion that would not have been possible otherwise. While leaving her brother into a nearby town they noticed as they rounded a bend the reflective jackets and familiar sight of stopped vehicles of a dipping checkpoint. Fionnula says, "I turned the car around, let Gerald out to walk the rest of the way into Omagh and I headed of home." About

[424] Other businesses in the area are digger drivers, lorry drivers and farmers.

[425] Vernacular term for Government employees checking that the public is using the appropriate road legal diesel by randomly ‘dipping’ petrol tanks at random check points.

[426] The law until recently had specifically stated that ‘red’ diesel (red being the colour of agricultural diesel) should only be used in agricultural vehicles. The agricultural diesel in the Republic of Ireland was green and as such was until recently exempt.

thirty seconds later her phone started to ring and a car was gaining quickly behind her. When it over took she answered her phone, it was her brother informing her that several officers had just left the scene in her direction at great speed. "Sure enough" Fionnula continued, "I could see about two hundred yards ahead of me the two cars had stopped and were waiting. But I knew they could do nothing if your car is parked and locked." Fionnula proceed to pull over and park, she continues, "I grabbed my fags, coat and mobile, locked the car and called Eammon to come and pick me up. We went back the next day to pick up the car."

11.7. INTERVIEW 6: SUB-CONTRACTOR

M Coutts 10:30 17.08.05 Director MC Contracts

Contacted via mutual friend Mike on the morning of our interview phoned to change the location of our meeting due to a last minute change on one of his sites.

11.7.1. Company Context

Company began '98. It is a small building contracting company, who undertake domestic scale renovations and new build, and recently had secured a sub-contracting contract for a large construction organisation.

Company structure

Directly, MC Contracts, employees 0 people, all work is subcontracted usually between 4-10 people working for MC Contracts at any one time.

Technology usage: CAD; e-mail; word processing; pen and paper; internet (for sourcing materials). Approximate size of average contract is £20,000. Sub Contractors employed by MC Contracts must have their own insurance.

11.7.2. Interviewee

M Coutts, Director, MC Contracts

11.7.3. Mobile Usage

1. 8 - 10 years.

1(a). Phone Turned off at 6.00. Most useful for work, when on move, ordering/pricing materials, contacting subs.

2(a) and (b). Not overly concerned about the features of the phone, which sitting on the table was a rather distressed, scuffed and battered nokia phone. He used: SMS; Phone.

3(a). 10-20 calls, each under 5 minutes, 3-4 SMS

4. Yes, tries to avoid making calls and sets aside time to make a few calls when necessary.

5. Urgent 2; Need info (need to get or give it) 1; Checkin/up on site 3; Unnecessarily 6.

6. Said he and his workers were "like a network, all connected."

7(a). 5- 10 some are return calls.

7(b). 3-4

8. Will not answer in the middle of something (the phone rang and Mike said “I’m going to leave that because I know who it is and I know what its about so I can call him back later”).

9. Information regarding schedule of works (when sub-contractors will be ready etc.) 1; Calls re: new work 2.

Receives a lot of junk calling since signing up with yell.co.uk

10. On the spot 1. 90% of the time, the rest iof the usage is on pricing.

11. Straight down to business (phone rings again “I’m going to take this case I know what its about” the call lasted 20 seconds and we picked up our interview where we left off). In this case the call was regarding earth moving from one of Mikes sites, he knew those responsible would be calling to ask what to do with it. Mike had another site requiring earth, and directed them to deliver it there. This call saved MC Contracts approximately £1000, as dumping the earth from a site would have a charge of approximately £250 and ordering earth for the other site would cost approximately £750.

12. n/a.

13. n/a.

14. ‘Necessary Evil’ not so much the phone but who’s on it, clients can go on and on, needing reassurance about things previously covered.

15. When there is a change in plans. Keeping a job running, ordering materials and getting them on the spot or with 24 hours. About organisation of people and resources, particularly when things change.

16. Not often.

17. No.

18. Turns it off at 6:00 and won’t answer if he knows it’s not urgent.

19(a). Allows more flexibility for problem solving and organisation and can call anywhere.

19(b). Tries not to call during the day as it distracts, will call at lunchtime. People getting distracted when receiving calls.

Due to the modest nature of the interviewees company he places a lot of trust in his colleagues and does not find it necessary to call and check up, they are sub-contracted and are on a fixed price contract. However he finds it useful to change and reorganise quickly, which saves time and inevitably money.

Mike felt strongly being able to place an order on-line would be useful.

11.8. INTERVIEW 7: SUB-CONTRACTOR

Aidan Mullan, Mullan Joinery

11.8.1. Company Context

Aidan has been a Joiner for fifteen years. Firstly for five years as an apprentice, and ten years as a full Joiner. Typical contract is private one of houses doing the joinery work of the joisting, the roof or the finishing timber detail.

11.8.2. Company Structure

Previous the firm was a five man team this has now been reduced to three men. This reduces the logistics as all men will be working on the one site at the one time.

11.8.3. Mobile Usage

Never uses landline, always mobile as its cheaper on the contract.

7 years

Started a job as a foreman and was made to get a mobile phone for this job. The phone had to be purchaced by Aidan but the company provided an allowance for its usage.

(a) and (b) SMS for personal use only, phonebook, Alarm Clock and reminders, Camera for personal use only.

1. -

1(a). 5-10 calls per day

1(b). 1-2 calls per day

2. Answers it, it doesn't bother him.

3. 1. Need Information, would have used it for checking in prior to down-sizing from 5-2 men.

4. 99% of the time will get an answer on the spot because he calls the right person. Rest of the time it's a recall.

5. –

5(a). 5-10 calls

5(b). none. No SMS for work purposes.

6. No does not feel distracted, but can be a bit of a problem in dangerous places.

7. 1 mostly, people asking when you are coming to a job or where are you. 2 looking for money.

8. On the spot 1, within the hour 2, within a day 3.

9. Very little small talk when people call

10. A little mostly business
11. More farmilar associates will make more small talk.
12. Up heights, on a roof, or holding something. That second you automatically go to answser before stopping yourself.
13. Most of the time its useful, calling re: getting hardware and materials are they available do they need to be ordered, finding information for clearing up details.
14. Had to explain ‘fire fighting’. Not really, fairly well organised after 15 years. If necessary its easier to jump into the van and get it rather than call and get someone else to deliver. Occasionally when arriving as a sub-contractor on a larger project and the materials are not there or the site is not ready for them, call the foreman to find out what is going on.
15. No but you might be in a hardware store once a day.
16. Don’t turn it of, but wouldn’t answer an unfamiliar private number would let them leave a message. Nuiance calls from sales men, number recorded in phone and they are ignored.
17. -

17(a). Benefits, couldn’t do without it.When we wasn’t self employed he did not use it as much. Used for personal problems, can keep in contact with other people and change plans which is very useful. Phone is simple, not fancy, sturdy, fits in holster and has fallen of roofs and is still working. When he built his own house he use his mobile very heavily as he was acting as main contractor. Builders asking questions which needed to be answered.

17(b). No.

11.9. INTERVIEW 8: SUB-CONTRACTOR

Kevin McCaffery, Tiler, Self employed

11.9.1. Company Context

Self employed for four years, before that was an apprentice. Typical size of job is the tiling of one off houses, floors, showers, kitchens.

11.9.2. Company Structure

Works alone

11.9.3. Mobile Usage

Ocassionaly uses landline but mostly mobile

1. 6 years\

1(a). had it from 16 years old so always had it.

2. (a) and (b) SMS. MMS (personal only), Phonebook, has internet but doesn't use, uses calandar, uses alarm clock

3. –

3(a). some days not one others 3-4 a day.

3(b). Not many, always personal

4. Doesn't get distracted when making a call

5. Need Information 1. Rest not applicable.

6. On the spot 1, rest not applicable.

7. –

7(a). Sometimes none, sometimes ¾.

7(b). Personal only 2/3

8. Yes it distracts but you can get back into it quickly.

9. Checking in, checking with owner, how he wants things done, easier to go on what is said than what is drawn.

10. On the spot 1. Rest not applicable.

11. On pay as you go so when he gets calls its straight to business

12. When he makes calls its straight to business

13. A little

14. When someone is ringing because you are supposed to be somewhere and aren't. Or you've priced a job wrong and you know you won't make money on it, don't answer when they call.

15. When you care coming to details, where the client wants a border or a centrepiece or a particular pattern in the tiles, you can just give them a call and find out or get them to come round. Or if they want more of the shower or shower room tiled than originally agreed.

16. Had to explain fire fight. No

17. No.

18. Never turns it off, they calls previously mentioned he would not answer.

19. –

19(a). Nothing to compare to as he always had a phone. Can't imagine working without one. Loss time if he didn't have one, would be able to price jobs son compedatively.

19(b). None.

11.10. INTERVIEW 9: SUB-CONTRACTOR

Aidan McQuaid, Plumber

11.10.1. Company Context

Aidan works with two other people, self employed has been a Plumber for eleven years and was an apprentice for six years prior to that. Contract size is one off houses, but has started a 30 house development.

When meeing Aidan he left a message to call him back no info at all.

11.10.2. Mobile Usage

1. Using a phone for 10 years.

1(a). Got it for work because he wanted to be contacted.

2. (a) and (b) uses SMS, not MMS, Uses phone book not internet, uses calandar reminders and the alarm clock and calculaor.

3. –

3(a). 15-20

3(b). not many 1-2.

4. Not dostracted when making a call but yes when receiving.

5. Needs Info 1, material orders 2,

6. On the spot 1, rest within the hour.

7. –

7(a). 5-10 calls

7(b). 5 a week

8. Gets distracted when receiving a call but not much.

9. Information needed for organising 1, requesting presence for work.

10. On the spot 1.

11. Gets straight to business

12. Some small talk with familiar people

13. Yes if familiar

14. No, not usually in dangerous position to answer phone. A little annoying in a tight corner.

15. Having to pick up or organise materials

16. Had to explain fire fight, no

17. No

18. Puts in on silent if there were visitors in but answer it for anyone.

19. –

19(a). Yes organising

19(b). Can't say

11.11. INTERVIEW 10: SUB-CONTRACTOR

Ryan Teague, Builder

11.11.1. Company Context

Apprenticed for a few years and then at 21 went out on his own with his brother working with him. Been a builder for 4.5 years now.

11.11.2. Company Structure

4 brickies and 1 labour all working on one job. Builds one of houses and sells them on, so a small developer. Technology usage, his wife uses work processing for the accounts but that's it.

11.11.3. Mobile Usage

1. Since he started

1(a). Always had one.

2. (a) and (b) SMS yes, text boys where they are being lifted of if there is a change in plans. MMS no, Phonebook yes, Internets, has it doesn't use it, doesn't use calandar, uses alarm clock and the calculator.

3. –

3(a). over 10

3(b). 5-6 most before bedtime to inform boys of plans for tomorrow. SMS in daytime is personal.

4. Doesn't get distracted, calls last 2-3 minutes and you get on with what your doing.

5. Mainly need information, materials and re-organising people or to confirm details with architect. Rest not applicable.

6. On the spot 1, unless it's a big problem then a meeting is arranged within the week to sort it out.

7. –

7(a). 7-15

7(b). very little. Sometimes people will SMS prices which he doesn't like because there is no room for negotiation. In one case hw called and complained about being texted a quote and the guy was busy which is why he did it, ddhe then negotiated a better price afterwards. 90% are personal.

8. Silent is very useful, in a meeting its distracting, but 99% of the time he answers the phone.

9. Request for pricing 1, what is your progress 2, material inquiry or order 3, complaints (about people on job, not enough or what are you coming?) 4.

10. On the spot, rest not applicable.

11. Some small talk always before business.

12. Yes, can't just get down to business, got to have some chat.

13. Yes

14. Not personally, but have had to check labourer for using a few times.

15. Getting work, a call to see if you interested and when you'd be round to look at plans. Contact workers to change the plan for tomorrow.

16. Not in bricklaying, you have to have the material in advance, you see problems develop.

17. No

18. Never turn it off, almost always answer, you might not, then have a think about what your going to say and then call back.

19. –

19(a). Organising work and men, couldn't do without it. for organising materials.

19(b). No down sides.

Changes, hard to avoid changes because the client comes out and wants to move the fireplace, or their planning on a potbellied stove rather than a standard fireplace, that might not be in the drawings and your chimney breast would have to be very different. Or they want to make a room bigger and you have to accommodate them if you can after all its their house.

There is enough looking at plans before construction, Planning, Building Control Architect, there is nothing to be gained nby trying to look at the plans further to avoid changes because the owner might not understand the plans anyway and will wait and understand it more as the building goes up and that's when they'll make the changes anyway no matter how much you look at them before.

11.12. INTERVIEW 11: SUB-CONTRACTOR

Barry Winters, Plumber

11.12.1. Company Context

Was an apprentice for 4 years and has been self employed for 14. Contract size is private houses only. Only does contracting on fitting the environmental bio-mass boilers.

11.12.2. Company Structure

Works with ½ others.

11.12.3. Mobile useage

1. 7-8 years

1(a). Got it for work, did not get it immediately, many others had m/b before him.

2. (a) and (b) SMS for personal use only, MMS for personal and work, taking a picture of his work etc. Phone book yes, has internet does not use. Calander yes, not the alarm clock but uses the calculator.

3. –

3(a). 2-10 depending, materials or details of work.

3(b). Only for personal use 1-2.

4. Some people can be a bit of a pain but you have to talk to them, you get back to work in 5 minutes though.

5. Information re: supplies, the rest not applicable.

6. On the spot 1, the rest not applicable.

7. –

7(a). 3-12

7(b). Occasionally for 'where are you' for a job you should be on but are not.

8. SMS not so bad you can pick it up when ever, but calls can be a little.

9. Asking to come to a job 1, Where are you 2, calling another plumber for info.

10. On the spot 1, rest not applicable.

11. You try to get to the point as soon as possible.

12. He gets straight to business.

13. Mostly straight to business

14. Up a ladder, usually vibrates before it rings gives you warning, betters as its not distracting. Had to have a word with his apprentice when he started, emergency personal calls ok but that's all at work.

15. Nearly would go back home to get it if he forgot. When you're the sub-contractor and the main contractor hasn't gotton materials and you have to cause you've arrived on site and there are no materials.

16. No always try to organise a couple of days ahead.

17. Don't encourage it so won't go immediately or will put it of so as to not encourage people to come immediately.

18. Silent at mass and the cinema but not off. I wouldn't answer work related calls if they were from time consuming individuals, give them a call back when I have more time on my hands. If it's a contractor you should answer whatever, as they are the ones who give you work. If I don't recognise a private number I usually will not answer at night, I get back to them in the morning.

19. –

There are benefits such as calling other plumbers for advice. If I were called out because a boiler was broken or I was having a hard time installing one or getting it to work I'd make a few calls to a few other plumbers. You see there a good chance that one of them has come across this boiler or this problem before. So a few minutes on the mobile could save you a few hours of twisting with a boiler.

19(a). Ex-girlfirends.

11.13. INTERVIEW 12: SUB-CONTRACTOR

This interview was held while on a short break with a builder/sculptor. The opportunity arose and given the interviewee dual vocations of building and sculpting it was seized. However the questioning in these opportunistic interviews was not as structured as the others.

11.13.1. Company profile

Douglas Marsden is a sculptor, very well known within the international 'netske' circles. When not carving these highly sought after items he freelances as joiner and project manager in his home of New Zealand.

11.13.2. Interviewee

Douglas Marsden

11.13.3. Mobile Usage

The cost of mobile phones and contracts is—relatively speaking—higher in New Zealand due to a smaller number of competitors as compared with the UK.

Do you need to change much?

Architect is pretty on to it, you can get the idea what they are after for the drawing and detail sheets. You can have dozens and dozens of them but they give you an idea what effect they are looking for.

Does it help when you have an idea what effect they are looking for?

Yes, but you get that from the drawings… But these bloody computer drawings… Sometimes I'll go over them in pencil, picking out details, you know! Highlighting which areas that are hardwood.

What about problems with the builders on site, you ever have problems managing them?

You know a cowboy builder the moment you walk onto the site… untidy materials, tools everywhere.

11.14. INTERVIEW 13: DESIGNER

Desmond Ng

11.14.1. Company Context

Desmond Ng is the Director of MNA Architect an architectural practice based in Malaysia that has been operating from 1990. Desmond is also a senior design architect in an architectural practice in Northern Ireland.

11.14.2. Company Structure

The architectural practice in Northern Ireland where Desmond spends most of his time is a 35-person office. This is comprised of 2 architects, 3 engineers, 2 surveyors, 2 administration, the remaining staff are draughtsmen. The practice started in 1905 and the projects range from small domestic scale houses to golf course master plans.

11.14.3. Mobile Usage

1. 23 years.
    a. Mobile phone purchased for work to keep in contact with office.
2. –
    a. SMS, MMS, Phone book, Internet, Calendar, Alarm clock, Note pad, Music, Camera.
    b. SMS, MMS, Phone book, Calendar, Alarm clock.
3. –
    a. 0 calls made per day.
    b. 5 txt per day
4. Does not get distracted when making calls, sets time aside during day to phone people.
5. (1) Information (2) Organising (3) Contacting consultants for progress (4) Contractor to respond to a query.
6. Contractors call back within the hour, authorities call back within the week.
7. –
    a. 5.
    b. 0
8. Yes, in meetings.
9. (1) Suppliers (2) Consultant (3) Contractor needs information.
10. Usually obtains an answer on the spot.
11. No small talk.
12. Straight to the point.

13. Some people start with small talk but usually I don't indulge and get them to the point quickly.
14. Call centre requests are usually filtered out when in the office but outside the office they come straight to the mobile phone.
15. On holiday to call the office, but now feels this is a sort of insecurity. Previously the interviewee would have thought some things were very important and needed to be resolved urgently. Now he believes nothing needs to be dealt with immediately.
16. No
17. Previously yes, particularly when managing projects the need to fire fight arose. Not any more as the interviewee is now primarily focused on designing and not constructing.
18. Interviewee would not answer a call centre and would rarely not answer if it was someone for whom work was not yet ready. The interviewee would consider his response and then call back.
19. –

    a. Substancial reduction in "sorry they are not in." The SMS is very useful as you can "deliver" information to their phone and you know its there.

11.15. INTERVIEW 14: DESIGNER

Puja Basu

11.15.1. Company Context

The Interviewee is an Urban Design working for EDAW Plc, who are a multi-national urban design company. The Edinburgh office is comprised of 42 staff, worldwide EDAW employ over 1800 professionals.

11.15.2. Company Structure

EDAW have companies in the US, UK, Asia, Middle East and Australia. The are all controlled centrally by EDAW Firmwide, which maintains co-ordination between the offices. Each office is comprised of one Managing Principle, Principles, Directors, Associate Directors, Urban Designers, Landscape Architects, Assistant Urban Designers, Assistant Landscape Architects and Technicians.

11.15.3. Mobile Usage

1. 1.5 years

1(a). Personal mobile is used when out of the office

2. –

2(a). SMS, MMS, Phone book, Internet, Calendar, Alarm, Note pad.

2(b). SMS, MMS, Phone book, Calendar, Alarm, Note pad.

3. –

3(a). 3-5

3(b). 5-10. Feel its better to SMS when the matter is not urgent, it gives the person time to consider and reply.

4. Prefer to concentrate on the call rather than be distracted.

5. (1) Need Information (2) Urgent (3) No landline (4) Unnecessary (5) Checking in.

6. (1) On the spot (2) Within the hour (3) Within the day (4) Within the week.

7. –

7(a). 5-6 calls received a day

7(b). 5, SMS is usually for less pressing, more casual matters. Calls are for immediate or complex matters that would be more difficult or too slow via SMS.

8. Yes receiving a call distracts.

9. (1) No landline available (2) Urgent (3) Need information (4) Unnecessarily (5) Checking in

10. (1) On the spot (2) Within the hour (3) Within the day (4) Within the week.

11. Occasionally

12. Sometimes, depending on how well the interviewee knows the person they are speaking to.

13. Sometimes, if they have spoken, met before.

14. Yes. There are particular times the mobile phone is an annoyance.

15. Yes.

16. N/a

17. N/a

18. Never turn it off, never not answer a call.

19. –

19(a). Mobile phones help keep the business together as it is rare for everyone to be in the office at the same time. Helps to keep in touch with the office, colleagues and clients. A feeling of security. Valuable for work related socialising and organising drinks or an evening out.

19(b). A lot depends on the users mobile etiquette. The can be a disturbance in meetings if people do not turn them of and insist on answering them all the time. Also there needs to be an unspoken understanding regarding work and personal mobile phones. The personal line being respected particularly at weekends or during holidays.

11.16. INTERVIEW 15: CLIENT

Liz McIllhagger

The interviewees house was renovated by a small domestic building contractor. The interviewee took a particularly active interest in the work to ensure the finished renovations would meet her requirements.

Mobile Usage

1. 18 years

1(a). Purchased because of convenience.

2. –

2(a). SMS, MMS, Phone book, Internet, Calendar, Alarm clock, Note pad.

2(b). SMS, Alarm clock, calculator.

3. –

3(a). 90% of daily calls during the renovation were focused on the renovation. Approximately 8 calls per day. The interviewee will made a list of issues from these calls and then visit site and look at each one in turn.

3(b). 90% of SMS texts were renovation related. Approximately 5 SMS per day. Interviewee preferred SMS as it allows more control over what is said.

4. Interviewee turns phone off quite a bit, as it is distracting when it rings.

5. (1) Call contractors (2) Clarify information (3) Ensuring the contractor was using the correct information; however the interview feel that she was interfering in the contractors domain when she would do this (4) pre-empt a potential problem; again the interviewee felt self-conscious that she was identifying potential problems before the contractor. However she had a very clear vision of what she wanted.

6. On the spot or agree to meet and discuss.

7. –

7(a). Receive 2 calls a day.

7(b). None

8. No. Although the interviewee has previously indicated they are quick to turn the phone off to prevent being disturbed.

9. (1) Contractor wanting to clarify information.

10. Interviewee prefers not to rely on giving verbal answers to questions, but rather prefers to consider it and pass a written instruction or drawing to the contractor.

11. Calls received are usually straight to small talk about the family.

12. Interviewee gets straight to the point, no small talk.

13. Finds the bank is worst for small talk, and its usually nothing urgent or project related.

14. Find mobile phones an annoyance as people react instantly to it, even if engaged in another conversation.

15. Interviewee would not be without a mobile phone, however they had to think for a moment to give a specific example. Useful in emergency and for immediate contact, very useful to target a specific person.

16. No.

17. No.

18. Yes, working, in a meeting, doing something that requires all your attention. Can use it to compartmentalise your activities to your own schedule.

19. –

19(a). Yes, can select and prioritise and then judge the urgency of what has to be dealt with.

19(b). Yes, other wanting urgent contact or action, however the mobile phone allows the interview to resist responding to these types of people. Typically it is a type of person who habitually has urgent problems.

12. APPENDIX A-3: CASE STUDY.

As a means to better understand the intricacies of the process of design and construction, an attic conversion was undertaken by the author. This project was executed from September 2005 to February 2006, and is recorded here with reference to Appendix A.4 and A.5 that contain specific drawings and documents from the project.

The continuity and chain of events related to a particular element within the overall construction can be difficult to follow. There are instances during construction that have been interrogated in considerable detail within this Thesis, and, to make the events surrounding these elements easier to follow[427] they have been isolated and described separately. The events and details specifically surrounding the fire escape window, the staircase and the structural changes, have been isolated from the rest of the construction and is described in sections12.16, 12.17 and 12.18 respectively.

12.1. INTRODUCTION

The Client approached the author in July 2005 aware of the authors' background in architecture. The client wished to convert the roof space of the existing dwelling into an additional bedroom. This was a good opportunity for first hand involvement in a construction project, which would undoubtedly be beneficial in terms of data gathering for this Thesis, providing of course the scope of the project would not require anymore than a single person in the role of designer. After two preliminary meetings, one of which was on site, and confident the scope of work was possible for an individual the author accepted the offer to act as architect for the construction project.

12.1.1. The Brief

To convert the roof space to accommodate another bedroom, if possible more storage and an en-suite was also desirable. The budget was approximately £10,000.

12.1.2. Architects Services

There was a limited range of architects services required, they were as follows:

Design development.

Submit and obtain Building Warrant.

Prepare Tender documentation.

Call Tender.

Site Supervision.

[427] Such as the fire escape window and the staircase

12.1.3. The Programme

The programme proposed (Figure 9.4) would target the submission of Building Warrant documentation to the authorities by the end of September.[428] With the approval process initiated, Tender Documentation could be prepared and it was anticipated we could call Tender by the second week in October.[429] This would allow 8 weeks for the Building Warrant application to be processed and 5 weeks for Tender Action, both would run concurrently and both should be returned before Christmas, and construction could begin before New Year.[430]

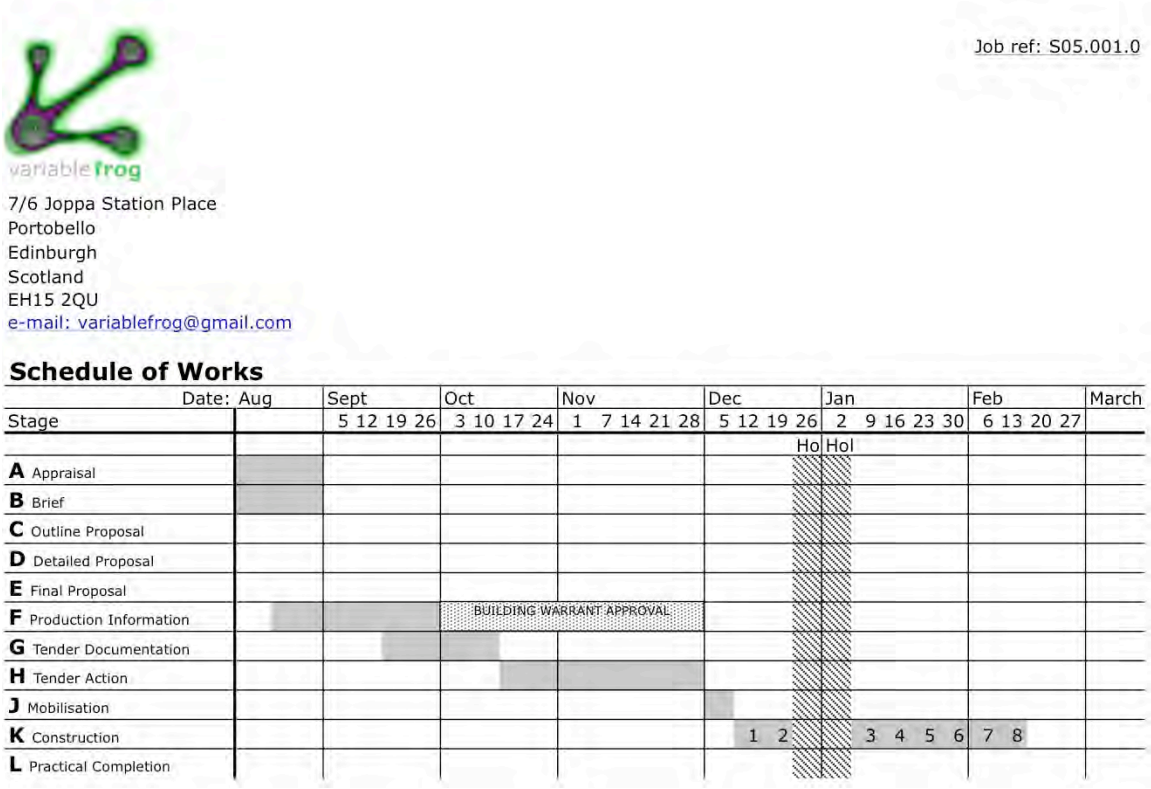

Figure 9.4 Gant Chart

12.2. PRELIMINARY DESIGN DEVELOPMENT

With attic conversions much hinges on the means available for efficiently constructing a staircase to fit into the space available while maximising the usable floor area. The initial site visit suggested two main possibilities. 1. Carrying the new staircase up in a similar place to the existing stair (Figure 9.5) or 2. Starting the staircase earlier and utilising more space on the loft level (Figure 9.6). While proposal 2 would take up more space on the upper landing, it would take up less

[428] Item F in Figure 9.4.

[429] Item H in Figure 9.4.

[430] This was eventually revised, to minimise disruption for the client, construction was rescheduled to start just after the New Year.

space in the converted roof space above, and that was the basis on which the design proceeded.

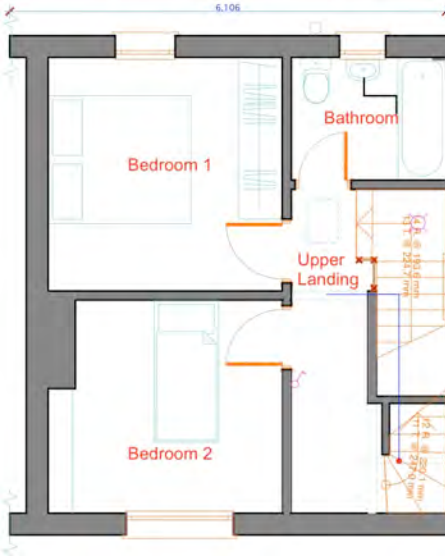

Figure 9.5 Proposal 1

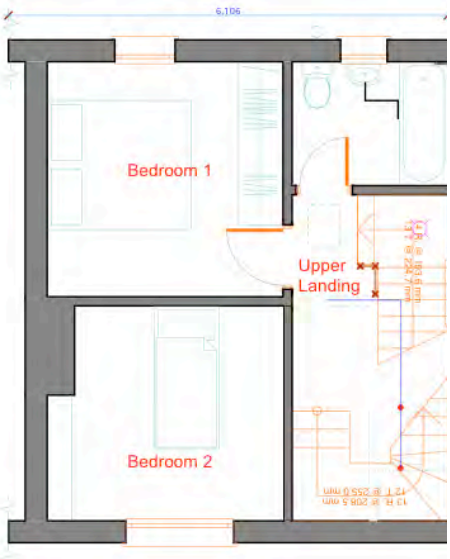

Figure 9.6 Proposal 2

12.3. FINAL PROPOSAL

With the location of the staircase agreed, the final proposal[431] that included an en-suite with bath, toilet and hand basin was arrived at quickly. The main driver for the layout was to ensure the staircase would comply with building warrant standards (thread, rise, pitch and head height clearance etc.) and would require careful construction around the window on the existing staircase (Figure 9.6).

12.4. BUILDING WARRANT: APPLICATION

To ensure safe standards of design and construction are achieved, before construction starts a Building Warrant must be obtained from the local Council Building Control Division of the Environment Department. This is obtained by submitting the required drawings and calculations to the Council with the appropriate fee for processing.

12.4.1. Warrant Consultation

The architect had extensive experience with the Building Control processes in Northern Ireland, a similar yet slightly different system exists in Scotland, upon developing the final proposal the architect wished to have a consultation with the Building Control office prior to submission to ensure that appropriate and correct information was being be submitted.

[431] The final design as submitted to Building Control can be found in Appendix A.4, Section 16.1.

A consultation was not possible, the Environment Department was contacted and the following policy exists:

As there is no actual application submitted, I could not be connected to the Officer in charge of it.

Because multiple Officers deal with each area it is not know which office will process the application when it is made.

This division "*do not do*" (unknown quote) consultations prior to Warrant application because of the previous points.

I could if I wished go to the East Lothian headquarters in Haddington (located on the outskirts of Edinburgh) and "*maybe there would be an Officer around who would talk to you if you didn't mind waiting*" (unknown quote).

12.4.2. Building Warrant Submission

There is a comprehensive guide for Building Warrant applications, stating what documentation and drawings are required and how many copies. To confirm the application fee category—which was slightly ambiguous—the Environment office was contacted. It was confirmed with the appropriate department that our roof space conversion came under the 'conversion' fee of £100 and it should be submitted with the application.[432]

Scotland has a series of 'Approved Documents' (AD), which cover building construction specification in various areas such as structure and fire safety etc. Much of the time spent on the project at this stage was invested in finding and including the appropriate specifications, for skylights for example or the British Standard (BS) to which the smoke alarms must comply. Given cost constraints and the time allotted to this stage of the project, it was not possible to elaborate further on the design.

The warrant was submitted on the 10th October 2005. It is usually the case that—subsequent to submission—the authorities request additional information that may have been overlooked or deemed unnecessary in the original submission, and we were anticipating this correspondence.

Shortly after which a mobile phone call was received to inform me that the Building Warrant application fee information provided by the Environment Department was incorrect, the application would not be processed until the correct fee was submitted. It was necessary to contact the client by mobile phone, they lived close to the Building Control Division and were able to write a cheque for the subsequent amount and deliver it, in person to the Building Control Division.

[432] See Appendix A.5, Section 17.4, Warrant Application.

12.4.3. Environment Department

The client—on the aforementioned visit—discovered that the Environment Department at East Lothian Council were understaffed due to an Officer leaving, as such it was indicated to the client that Warrant applications were currently taking 16 weeks to process, it was suggested that this could work for and against us. Obviously the application could take 16 weeks but given the scale and scope of the project it might be pushed through the process much faster.

12.5. CALLING TENDER

Having submitted the Building Warrant application to the Environment Department, the next stage was to contact several building contractors for expressions of interest in carrying out this building work, and invite those interested to submit a tender offer.

12.5.1. Tender Documentation

Before calling tender further information and detail was added to the drawings. This was to enable those invited for tender to calculate an accurate cost. The following information was discussed with the client and added to the Tender drawings: -

Surface finish specification

Bathroom specification

Electrical fitting

12.5.2. Tender Action

Three main contractors were chosen, two were known to the client, one of whom was a personal friend, and one was recommended to the architect. They were contacted for a verbal expression of interest; upon receipt of a verbal interest they were forwarded two copies of the Tender Documentation[433] along with a tender invitation. One of the contractors made contact again via mobile phone to obtain further information regarding additional specification and the scope of the work required.

12.5.3. Sub-Contracted Works

Several items were necessarily sub-contracted to specialists, the staircase, built-in wardrobe and the scaffolding. These items were not included in the Tender Documentation to the main contractors, they would be tendered separately, and the chosen specialist contractors would be forwarded to the chosen main contractor and they would co-ordinate their respective works.

Three staircase manufacturers were approached and all gave similar quotations for a staircase. Two furniture makers were approached to submit tenders,

[433] This includes comprehensive drawings of the proposed and existing building, and a document to breakdown the cost of the different elements of work.

upon receiving the quotations the client decided to remove the built-in wardrobe from the project for cost saving. Two scaffolding contractors were approached to submit quotes for scaffolding as per the contractors specifications, both scaffolding contractors returned similar prices and the lowest was chosen.

12.6. BUILDING WARRANT: ENVIRONMENT DEPARTMENT RESPONSE

As the project was progressing through the Tender stage, the Environmental Department responded to our Building Warrant application. This was the correspondence, requesting further information, we were expecting. It was dated the 10th November 2005.[434] Written predominantly in the negative, it listed all the ways (but suggests it may not be definitive) in which the application has '*failed*', and lists the further information required. The letter is very specific and lists each Technical Specification (TS) that has not been addressed, and a description of the information required for the application to be successful.

The client having received a CC'd copy of the document was initially concerned that—based on this correspondence—a Building Warrant was unattainable. The client was assured that this was standard procedure, and a Building Warrant was obtainable.

12.6.1. Consultation with Environment Department

With an application now lodged and a specific Officer charged with its processing it was possible to contact the Officer and secure a date for a meeting (29th Nov 2005) to discuss the application.

The consultation was very effective, the Environment Department refer in relation to the Technical Standards to the considerably larger 'Domestic Technical Handbook' running at over 600 pages it contains all the specifications and appropriate regulations related to domestic buildings. A valuable document which can be bought, but it is also free to download from the Scottish Building Standards Authority (SBSA) website.

The Officer and myself went through each of the Technical Standards in sequence discussing what was required. The main addition to the application was structural information, which had to be submitted by a qualified engineer. This was necessary because of modifications being made to the roof structure for the provision of the new staircase. While the construction and appropriate increased loading was considered in the original application, and additional reinforcing was submitted as per the appropriate British Standard (BS 5268)[435] the structural modifications were seen as substantial enough to require a qualified structural appraisal.

Much of the information required was standard in the sense that it was not particularly specific to this house, it was specific to this region. For example target

[434] See Appendix A.5, correspondence 001_r_002.

[435] This is the Domestic Timber Loading guidance table.

U-values mean that there is virtually only one proprietary insulation system that can be utilised in roof space conversions in this area. Other standard stair information (pitch, number of treads and risers) must be identified and quantified on the drawings, not just—as had been the case here—described as compliant to British Standards.

12.6.2. The Consultations Effect

The consultation proved very useful, but prompts me to consider:

— Had it been possible to secure a consultation before the initial application we could have avoided the current position where 6 weeks after the application was submitted we have to tender for a structural package.

— Downloading the Technical Handbook is invaluable, however having it is not particularly useful unless you have a guideline of the specific technical specifications within it, which the design must comply with.

12.7. CONTRACTOR APPOINTMENT

By early December having received Tenders from the selected contractors, the main contractor was appointed and the client proceeded to refine the layout and specification with the chosen contractor to bring the project in at the intended budget. The contractor chosen is a small two-man firm, based in the English Midlands. The client had arranged alternate accommodation for the construction period and the contractor would move onto site, living and working there for the duration of the project. There would be no site office, or fax facility set up, the main form of contact between the contractor, client and myself would be mobile phone.

12.7.1. Design Specification

The contractor had some queries regarding the exact specification of some materials, in particular the insulation and construction method, the new skylight specification and the inspection checkpoints when the Building Control Division would inspect specific stages of the construction. When confirming the specification with the contractor, which was usually over the phone, this verbal information would be confirmed with a follow-up SMS text message (Figure 9.7) so as to remove any ambiguity surrounding reference numbers and specifications.

Figure 9.7

12.7.2. Design Refinement

This included omitting the en-suite (and one skylight) and instead making it a walk-in wardrobe, this had the effect of obviously reducing cost and also left some of technical issue raised by Building Control in their response to the initial application void, as the were directly related to the provision of an en-suite.

12.8. COMMUNICATION PROTOCOL

In the absence of any of the typical mediums and standards for recording and filing paper based communications that would normally be available on a construction project[436] it was necessary to develop an alternative for recording and filing communication that would be almost exclusively conducted by mobile phone. Specifically it would be beneficial to be able to back-up messages received and sent from a mobile phone, along with the recipients of those messages and the date and time on which they were sent. This seemed like a useful function and the first course of action was to see if software existed which had been designed to do something approximating this already.

12.8.1. Tools

BluePhoneElite (Figure 9.8) is a downloadable (free to use for a limited period) software that provided the functionality that was required. It could connect to a mobile phone via Bluetooth and it would create a copy of any messages on the mobile phone both sent and received, along with the recipients and the times and dates. It also had the capability to back-up the contact list from the mobile phone as well. It required a computer that had Bluetooth capability, for this it was necessary to purchase a Bluetooth module[437] (Figure 9.9 Bluetooth Module) which would plug

[436] Letter and fax in particular, as these are considered 'official' and are used to confirm verbal instructions and agreements. They can then be filed and retrieved if necessary.

[437] Most computers now come with inbuilt Bluetooth capability, the computer being used for this did not which is why it was necessary to buy the mobile.

into a computer and facilitate the communication between the mobile phone and the computer.

Figure 9.8 BluePhoneElite

Figure 9.9 Bluetooth Module

The BluePhoneElite software also facilitates sending SMS messages straight from the computer via the Bluetooth connection to a mobile phone.

12.8.2. Protocol Usage

To use the chosen software, first the Bluetooth functionality on both the mobile phone and the computer needed to be enabled. As there was only one computer that was using for this, the Bluetooth module remained attached and enabled permanently on the computer. However on mobile phones the Bluetooth functionality puts a considerable strain on the battery and as such Bluetooth was enabled for this process and disabled immediately afterward.

As I was in close proximity to the computer most days and I would have my mobile phone and all the equipment close at hand, it only required approximately 5 minutes to back-up my SMS messages. The first occasion took slightly longer—approximately 10 minutes—as it was necessary to 'pair'[438] the devices for communication first. The process was reasonably straightforward for anyone with some technical knowledge of computers, Bluetooth and mobile phones.

12.9. BUILDING WARRANT: 2ND ROUND OF DOCUMENTATION

It was possible to start addressing the information that the initial Building Warrant application had failed to provide. As well as calling tender on the structural package, the design was amended and the information requested was provided.

12.9.1. Structural Package

Five Structural Engineers were obtained via personal recommendation. Two agreed to submit a tender proposal for the Building Warrant package, and drawings of the existing and proposed designs were submitted to them. By the 16th December 2005 a Structural Engineer had been appointed.

[438] This is terminology describing the set up of devices to talk securely to each other.

12.9.2. Technical Specifications

With access to the Domestic Technical Handbook it was possible to address each specific TS and provide the necessary information. The specification for the partition walls and doors were obtained from the Gypsum specification handbook, similarly the ventilation requirements of the roof space were set specifications and calculations that were easily added to the drawings once they were obtained. The roof space construction—in particular achieving the recommended U-values[439]—was more complex. The U-value requirements are quite high in Scotland; they are achievable with a specific insulation manufacturer and system, however it is expensive. It was necessary to negotiate with the contractor on where the expensive insulation system would have to be used and where we could use an alternative cheaper system. Once this was agreed it was possible to proceed with the appropriate detailed drawing and specification.[440] Further staircase and skylight information was provided, which proved time consuming as it was necessary to search many pdf[441] files on skylight specification to ensure the appropriate amount of trickle ventilation, day-lighting, and ventilation was provided.

12.10. BUILDING WARRANT: 2ND SUBMISSION

It was now mid December, the client had booked the contractor to start mid January. To avoid unnecessary time wastage the second submission was made in person to the Building Warrant Officer at the Environment Department on Tuesday 20th December 2005. We met and systematically worked through then items that required further information as listed in their correspondence of the 10th November 2005, confirming that each had been addressed.

12.10.1. Technical Specification

Each Technical Specification that had not been addressed in the first submission was highlighted for the Building Warrant Officer and at this meeting each item was worked through systematically and approved by the Building Warrant Officer. Confirmation was required on the specifics of the fire escape skylight, once confirmed it was added to the relevant drawing and included in the submission.

12.10.2. Structural Package

Within the Environment Department the structural aspect of the Building Warrant is dealt with by a different Officer, the name and contact information of the Structural Engineer appointed to provide the structural documentation was submitted with the second submission. The appointed engineer intended to submit the structural package before the office stopped work for Christmas holidays.

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[439] U-value, is a rating given to material that indicates how well it prevents heat loss.

[440] This became drawings AA-04, AA-05 and AA-06. See Appendix A.4.

[441] Portable Document Format, a standard document format as developed by Adobe for the exchange of documentation.

In actuality it was the 5th January before the structural package was sent to the authorities. The engineer was proposing smaller reinforcing timbers than originally anticipated, and while this would mean a material cost saving, it had to be traded of against the cost of the Structural Engineers fee. The solution, as proposed, was to double up the number of ceiling joist by inserting new joist between the existing joists. There would be additional structural reinforcing anywhere that might incur higher structural loading such as the stairwell opening and the rafters that would support the new skylight.

12.11. MOBILISATION

After the Christmas break the contractor arrived on Sunday 8th January and would be commencing on site on the 9th January. At this initial site meeting the contractor, client and architect would walk through the proposed work on site.

12.11.1. Initial Site Meeting

On the 9th January the appointed contractor, the client and myself met on site and walked through the design and the existing building to identify any potential problems. A number of potential issues arose: -

- A water tank, which was thought to be redundant, was still being used by the bath on the floor below. It could not be removed as we previously though, and it would have to be replaced and relocated. This affected the position of the new partition wall, which was also discussed and modified in light of the water tank changes.
- It was apparent—from the discolouration on the underside of the existing roof—that the ridge tiles on the roof were leaking and would require attention.
- The Structural Engineer had proposed that the contractor provide the upper landing to the new stairs, due to the proximity of a window located at the top of the first floor stair. With the contractor we discussed an alternative method for securing the landing.
- There was some ambiguity surrounding the structural specification as provided by the engineer that would require clarification.
- The contractor requested confirmation of the size of the new skylight and the architect was to confirm the reference number for the chosen one.

12.11.2. Starting Construction

It was necessary to address some the issues that arose during the initial site meeting to ensure construction was not delayed. The contractor was contacted the following day via mobile phone and given the relevant information verbally. For confirmation of the critical information it was also sent in the form of a SMS message. As the contractor was planning to move promptly with the work the contact information for the Building Warrant Officer who was responsible for processing the Building Warrant application was sent to the contractor, again via SMS message (Figure 9.10).

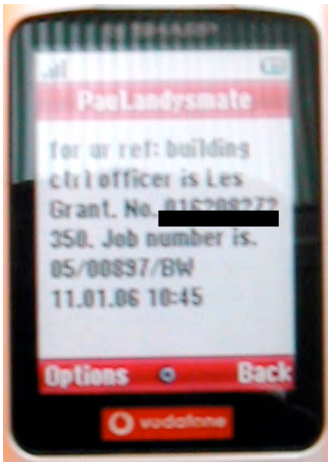

Figure 9.10

12.11.3. Structural Solution Changes

As construction commenced, obstructions were discovered under the floor in the roof space, which prevented the structural solution proposed by the engineer being achievable. This discovery was made on the afternoon of the 11th January and brought into question the completeness of the initial engineering survey.[442]

Progress was reliant on the structural changes being implemented quickly so work could proceed, as such the engineer was contacted on the morning of the 12th January and agreed to visit site that afternoon and undertake a more complete inspection and provide the contractor with a solution at that time. On the morning of the 13th the engineer contacted the architect to confirm that verbal instructions had been given to the contractor the previous evening, but the engineer wished to alter the revised solution that had issued to the contractor the previous afternoon.

The contractor was contacted and informed of the changes, at which point they took the opportunity to express dissatisfaction with the structural engineer and the various changes. This frustration was compounded as the final structural solution that the engineer proposed, which had in fact been proposed to the engineer by the contractor the previous afternoon, and at that time had been dismissed by the engineer.

12.11.4. Design Changes

After the structural work was complete and the roof space was cleared out and the new floor constructed, the client now able to visualise the space, decided to make some impromptu design changes. Two storerooms had been provided in the roof space and the client removed them in preference for having a larger bedroom. The engineer, who had visited site to confirm execution of the structural solution as per their instructions, informed the architect of this modification via a mobile phone conversation on 16th January.

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[442] The contractor believed the proposed structural solution to be a generic drawing and specification for the conversion of the roof space of this style of speculative house design.

The architects' first site inspection would be Monday 16th January, one week into site operations. At this point it would be possible to confirm any changes that have been made by the client and contractor, and update the relevant drawings and re-issue to the Building Control Division to keep then updated on any changes taking place.

12.12. OPERATIONS ON SITE

As construction work progressed a number of modifications were made to the original design, usually made the client for financial or aesthetic reasons. As the client was not aware that even minor changes may have effects on the designs compliance with statutory regulation, it was necessary to continually remind both the client and contractor how these changes would affect the Building Warrant application.

The situation became slightly problematic when the contractor lost his phone in a bar fight. For safety reasons the phone had been secured in his sock for the night, but somehow managed to slip loose during a heated and physical exchange. At this point the system—described in Section 12.8— which had been implemented to file and record communications via SMS message, proved useful for reinstating critical information when the contractor obtained a new mobile phone.

12.12.1. Site Modifications

At the first site inspection on the 16th January a number of issues arose, which required further action by myself as architect.

It was not possible to place the new skylight that was the fire escape window as required by regulation, exactly were show on the architectural drawings. Being a window for means of escape in the event of a fire certain dimensions[443] were critical and the contractor had installed it further from the ground than the regulations stipulated. A heated discussion followed between the contractor and myself, the crux of which was that the drawing—as drawn by the architect—was not possible, and the contractor had to improvise. The architect however had not been informed of this fact, and the contractors' improvisation of the escape skylight window position could have been closer to the drawn position. The contractor had positioned the skylight to maximise views with little or no consideration for its function as an escape window. The contractor would have to move the window as close as possible to the regulatory position, and Building Control would have to be contacted to see if the regulations with regards to the windows position could be 'relaxed' in these circumstances.

The roof detail was also not constructed as per the drawing, the contractor had provided only a 25mm whereas 50mm air space was required between the insulation and the existing sarking.[444] Rather than build out the rafter enough to achieve the required air space that was dimensioned, the contractor had scaled the

[443] In particular the dimensions of the bottom of the window from floor level and from the edge of the roof were specified specifically in the regulations.

[444] See Appendix A.4 drawing AA-05

batten which was not dimensioned from the architectural drawings. The solution was to build out the existing rafters further with battens to achieve the required air space. This improvisation was again contravening the regulation, and all of the insulation that had been fitted was removed and refitted after the battens were built out to accommodate the 50mm air space.

At the clients request the contractor was proposing an alternative staircase solution. They did not have intimate working knowledge of the regulations governing staircase design and were requesting clarification on various proposals that were being considered. However after some discussion we agreed how best to proceed at this stage, which would leave the contractor and client with as several options with regards to the staircase design. I would work up the staircase proposal based on more accurate site dimension that were taken at the site meeting.

12.12.2. Confirming On Site Changes with Authorities

The Building Control Officer with whom we were dealing was contacted to discuss the design changes, however his responsibility does not extend to site and another Officer would be responsible for inspections. Site inspections would only happen when a Form,[445] which is issued to the client with the Building Warrant Approval, is returned to the Environment Department on commencement of construction. While all the appropriate paperwork had been submitted to the Environment Department, we were awaiting the Building Warrant Approval that would include the relevant Form which would then be completed and returned.

12.12.3. Building warrant Paperwork

The Building Warrant package arrived containing the approved drawings, several forms to be submitted (if applicable) at various stages of the on-site operations.[446] Although Building Control were contacted to discuss the procedure with regard to the Forms which need to be submitted, there seemed to be some confusion regarding who was required to be listed as ‘verifiers of construction’. The information received from the Building Control Division was not consistent with other sources. It eventually transpired that the information provided by Building Control was not accurate.

12.12.4. Electrical Verification

A previous correspondence issued by Building Control stated that electrical verification for the conversion of a room (providing it did not include a bathroom) was not required. By the time of construction this information was out of date and electrical verification was required. A number of electrical contractors were contacted both by the client and architect, however the client decided not to pursue electrical verification at this date. The conditions of the Building Warrant state that it

[445] A document package is issued to the client approving the works to be undertaken, and including specific Forms to be returned to the Environment Department upon commencement of works on site.

[446] Forms to confirm commencement; confirm verification of construction and confirm completion (after which the authorities will issue a certificate to verify the Building Warrant).

is valid for three years and upon issue a client has three years in which to notify the authorities of completion. It was decided by the client to prioritise a functional bedroom as quickly and economically as possible and before the expiration of the Building Warrant he would (and had the intention to) upgrade the electrical fittings in the entire house and obtain electrical verification.

12.12.5. Site Inspection by Authorities

Due to previous commitments the contractors were not on site for the inspection by Building Control, as they were now running behind schedule due to the delays caused by confirming design changes[447] with the authorities. They had temporarily relocated to a different site from Sunday 22nd January to Monday 30th January.

The appropriate Form for 'notification of commencement' on site was submitted previously, and a site inspection was arranged for the 25th January was arranged. The contractor was anxious to know when the inspection would be, upon receiving this information from Building Control I informed the contractor immediately by SMS.

The standard of the work carried out by the contractor was acceptable, however the inspecting Officer was unable to accept any of the changes immediately. The Officer did not come fully prepared with a camera to take photos but it was possible for photos to be taken and forwarded via e-mail to enable the Officer to consult with his superiors. I could only e-mail the general department e-mail address with the photos and before the information reached the inspecting Officer the e-mail was returned by someone experiencing problems opening the photos. This transpired to be a technical limitation of the individual not the technology and the Building Control Officer eventually came into possession of the photos. I would be contacted before Friday the 27th by the Officer, with definite responses to the site changes.

When contacted by the inspecting Officer by mobile phone (8:30am while brushing teeth in bathroom) I was informed the escape window in its current position was adequate, however the proposed stair design was unacceptable. The Officer was able to clarify what precisely what would and would not be acceptable with regard to the staircase regulations.

12.13. REVISED STAIR DESIGN

In an attempt to make a cost saving the client decided not to employ a specialist staircase manufacturer. The contractor purchased a 'screwfix' stair and would customise it to make it fit.[448] The contractor did not have intimate knowledge of staircase design or the regulations governing them.

On the second site visit (Monday 30th January) the stair requirements were discussed in detail with the contractor, as they were planning to be complete and off

[447] Such as the relocation of the fire escape window and the revised staircase design.

[448] Staircase quotations were coming back at approximately £1500 - £2000 pounds from specialist manufacturers. A 'screwfix' staircase bought 'of the shelf' was £800.

site by Tuesday 7th February. The majority of this site visit was dedicated to discussing the staircase requirement, it was abundantly clear that the contractor would need precise instructions as he was unaware of even the most rudimentary regulations regarding stair design.

12.13.1. Space

The converted roof space wall configuration was modified so as to allow the maximum amount of space for the staircase without affecting the head height of the door (D-07) or the space to the bedroom. This would allow for some flexibility given the contractors limited knowledge of staircase regulation.

12.13.2. Head Height

This was critical in relation to the staircase, because there was an existing height limitation at the base of the staircase. Existing head height at the base was 2300mm, the regulation head height over the staircase should be no less than 2100mm.[449] So if a single step encroached into the space under the existing ceiling it would reduce the effective head height to approximately 2070mm. Building Control had indicated that due to the nature of the conversion they could be flexible (approximately 20mm) with regard the head height but no more.

12.13.3. Kites and Winders

The regulations regarding kites[450] or as they are sometimes know winders are specific, and a drawing (AA-08) was forwarded to the contractor illustrating the critical dimensions and where they should be measured.

12.13.4. Mathematics

Conscious of the limited space available the contractor had purchased a staircase with the maximum possible pitch (42°) with a riser[451] or 223mm. They had neglected to consider the overall floor-to-floor height of 2640mm; this left a discrepancy of 40mm between the floor to floor height and the height which the staircase would be able to accommodate with a riser of 223mm. This discrepancy would have to be accommodated with a slight slope in either the upper or lower landing.

12.13.5. Solution

The architect visited site and discussed, measured and marked in detail the critical points with regard the winding steps (Figure 9.11), head height and the 40mm discrepancy. The contractor was shown where the critical dimensions must be measured from and where the stair must begin so that the critical head height was

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[449] See Appendix A.4, Section 16.2, Drawing AA-07.

[450] This is the name given to steps of a staircase that 'wind' if a staircase changes direction. They are sometime referred to as 'kites' as the shape of these steps from above resembles a kite. See Appendix A.4, Section 16.3 drawing AL-BC/08(b).

[451] This is the height of one single step of the staircase.

maintained. As the staircase is critical to the approval of the design the contractor was advised to arrange a final inspection to ensure the constructed staircase was compliant with the regulations.

Having agreed the solution with Building Control and the contractor the final design was updated on the relevant drawings[452] and forwarded to building control for approval.

Figure 9.11 Site Markings for the Staircase Winding Steps

12.14. FINISHING UP

The Client wanted the construction work finished up by the end of March. The final fix details were taking longer than had been originally anticipated and the client was also unhappy with the quality of the final fix work by the contractor. Both parties came to a less than amicable agreement where the contractor would complete the work to a certain stage and the client would employ another contractor to complete the final fix timber detailing.[453] Drawings were issued to Building Control confirming the final revision of the design on the 2nd March 2006. And the original contractor was of site by the middle of March.

12.14.1. Stairs

A Building Control Officer approved the stairs in a final inspection arranged by the contractor. The finer points of the project were also discussed during this inspection and any necessary work carried out.

[452] See Appendix A.4, Section 16.3 AL-BC/08 and AL-BC/09.

[453] Door frames, architraves etc.

12.14.2. Fire Doors

The timber doors and doorframes installed by the original contractor did not comply with fire regulations and it was necessary for the second contractor to refit them.

12.14.3. Electrical

The original contractor completed the electrical installation, however no official verification was obtained from a qualified electrician at the time of construction. The client was obtaining quotes from electrical contractors in August 2007 with the intension of obtaining this verification.

The architect had informed the client that an electrical certificate was advised sooner rather than later. Inhabiting a house without a electrical certificate might become problematic in then event of an insurance claim.

12.14.4. Space

The client opted for an unexpected layout of furniture that rendered the electrical layout less effective than it was intended.

12.15. SIGNING OFF

The architect had one final meeting with the client to discuss how the build went and to obtain feedback. The quality of work was satisfactory to a point, the client felt the first contractor should have been more upfront about their abilities, as the delays and remedial actions were more problematic than employing a second finishing contractor.

12.15.1. Contractor

The original contractor was known to the client, who assumed a higher level of integrity and honesty from a friend. This did not turn out to be the case and tricks which the client hope to avoid such as the contractor charging for a higher specification of item than was purchased, so as to increase profit, occurred in this instance too.

The quality of the final fix work by the original contractor frustrated the architect and client. The client eventually made the decision that it was beyond the original contractor ability to provide the quality required. As such the terms on which the contractor and the client parted were not particularly good, and the client employed a second contractor to remedial work where the standard was not acceptable, as well as do work which had been uncompleted.

12.15.2. Architect

The architects' fee was a reduced fee because of the limited amount of design development required. The fee was further reduced because the client decided not to proceed with the electrical verification. As some additional work would be required when the electrical work is completed and verified an appropriate percentage

remains outstanding to be paid upon verification of the Building Warrant by the council.

12.15.3. Final Spend

Final cost for the conversion was over the initial amount the client budgeted. The bill from the original contractor was for just over £9,000 pounds. The second contractors' bill came in at £2,500 for fixing skirting boards, remedial work to the doors and stair handrail. Professional fee's for the engineer and architect came to £1,800 plus building control fees of £250 plus miscellaneous items purchased by the client (electrical light fittings etc). The construction came it at approximately £15,000.

12.16. THE FIRE ESCAPE WINDOW EXAMPLE

In the initial design—which was submitted to the Building Control Division of the Environment Department on 17th October 2005—the skylight window in the attic was not classified as a means of escape. In was identified in this Building Control submission with the minimal amount of specification to allow the contractor and client some flexibility with their choice.[454] It was upon receipt of the Environment Departments correspondence of November 10th 2005[455] that the need to specify the window as a fire escape route was identified.

12.16.1. 10th November 2005

Correspondence received from Environment Department identifying that the new skylight window in the converted roof space would have to comply with fire escape regulations so that it could provide egress in the event of a fire.

12.16.2. 29th November 2005

A consultation meeting was held with the designated Building Control Officer to discuss the matters raised in the correspondence of 10th November 2005. Regarding the fire escape window, it should comply with the regulations taken from Approved Document B – Fire Safety.

12.16.3. 20th December 2005

A he new drawing[456] focusing specifically on the specification of the fire escape window—along with the rest of the information requested in the correspondence of the 10th November was sent to the Building Control Division on

[454] Appendix A.4, drawing Al-BC/09.

[455] Appendix A.5, Section 17.2 correspondence 001_r_002.

[456] Appendix A.4, drawing AA-02.

this date.[457] These drawings were also sent to the appointed contractor on the 21st December.[458]

12.16.4. 10th January 2006

On a scheduled site visit that took place on this day, the altered position of the window was identified. As compared to the escape window drawing and regulations the problem was that the critical dimensions of 'distance from eaves' and 'distance from floor level' were substantially greater than allowed.[459] The distance from the eaves was greater than 2 meters and the distance from floor level was approximately 1.3 meters.

The factors contributing to the problem were as follows. Firstly the window could not be positioned as per the drawing because of the location of an existing structural 'purlin' beam, and moving such a critical structural member would have a substantial cost and time implication. Secondly, the position, as restricted by the regulation, in this instance would leave the window in an unorthodox position, substantially below the eye level of the occupant. The contractor and client, unaware of the importance of the regulations governing the window, positioned it much further up the roof, and much closer to eye level. Thirdly, regarding its position as installed, it could have been closer to the regulatory position.

The negotiation of the window position started rather heated, the contractor was more than a little irate that the position—as per the drawing—was not possible, and that his improvised position was probably not going to be acceptable, but at the time of the site meeting, it was not possible to give a definitive answer as Building Control would have to be consulted. In the interim period the contractor would move the window to a position as close as possible to the stipulated regulations.

12.16.5. 25th January 2006

A Building Control inspection had been arranged and was carried out on this date, the Building Control Officer would have to consult his superiors regarding the window position. He was confident that a *relaxation* of the regulations would be possible in this instance and the current position—as close as possible to the regulatory position—would be acceptable. As these negotiations surrounding the window position were affecting the project progress the Building Control Officer agreed to contact me by mobile phone as soon as a decision regarding the window position was made.

12.16.6. 27th January 2006

I was contacted at approximately 8:30am by the Building Control Officer and informed that the window position would be acceptable in these circumstances and the regulations would be relaxed. The contractor was called on his mobile phone

[457] Appendix A.5, Section 17.2 correspondence 001_s_001

[458] Appendix A.5, Section 17.1 Drawing Issue.

[459] Appendix A.4, drawing AA-02.

directly afterward and informed so they could proceed with works that had been delayed while this decision was made.

12.17. THE STAIRCASE EXAMPLE

The initial design—as submitted on 17th October 2005—was acceptable to both the client and authorities, however further specification would have to be forwarded to Building Control[460] regarding the specific dimensions of the staircase. Changes made to the staircase were for financial savings.

12.17.1. 16th January 2006

At the site visit on this date the client and contractor had decided to reduce cost by not sub-contracting the staircase to a specialist as suggested by the architect, instead the contractor would purchase an off the shelf Screwfix staircase and modify it to fit the specific site requirements. The critical factor in the design was achieving the regulatory head height along the full length of the staircase. The *winding* nature of the first three steps of the revised screwfix staircase arrangement[461] could cause the head height clearance of the first step to fall 30mm below the minimum[462] if the staircase was not fitted very accurately. A number of alternatives were discussed, but unsatisfactory in different ways, these alternatives will none the less be further discussed with Building Control to access their suitability.

12.17.2. 25th January 2006

The alternative stair arrangements were discussed with Building Control at the site inspection on this date, the Officer was unable to provide a definitive answer immediately. It would be necessary for him to consult his superiors regarding the acceptability of one of the alternative arrangement, which seemed most practical.

12.17.3. 27th January 2006

Contacted at 8:30am and informed that there could not be a relaxation on the stair case head height clearance, and the alternative, which had been discussed with the Head of Department was not acceptable. It was necessary to proceed with the revised design, and install the staircase precisely to avoid compromising the head height.

This information was forwarded to the contractor who contacted the architect sporadically over the following days to check details of the staircase construction.

12.17.4. 30th January 2006

At this second site visit, it became apparent that the contractor had virtually no working knowledge of the regulatory requirements of staircase design, and which

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[460] See Appendix A.5, Section 17.2 correspondence 001_r_001, notes under Technical Standard 4.3.3, and correspondence 001_s_001, note under ‘safety’ section.

[461] Appendix A.4, Section 16.3, drawing AL-BC/08(b).

[462] See Appendix A.4, drawing AA-07.

dimensions—of which there are many in staircase construction—are critical, and what the acceptable range of these dimensions are in relation to the regulations. The contractor had purchased a staircase of the maximum possible pitch[463] to install, this staircase riser[464] height had not properly considered and the step height was not equally divisible into the over all distance from floor to floor. There was a remainder of 40mm that would have to be built up and recovered as a slight slope on the hallway floor. The importance of this was discussed in detail with the contractor who was going to start work on the stair in the coming week.

The architect was contacted during the coming week to confirm further details regarding what was, and was not necessary with regards to the staircases construction.

12.17.5. 13th February 2006

At the site visit on this date, the staircase was still not finished, the upper—of the shelf—screwfix section was in place, but the lower winding section at the base of the staircase had yet to be attempted. As illustrated in Figure 9.11 the requirement of the critical winding steps were marked out by the architect and contractor to ensure the steps would comply with the required regulations.

Although the contractor completed the steps to a standard accepted by Building Control the client was unhappy with the quality of the balustrades and handrail. The original contractor was of site, by agreement with the Client by the middle of March, and a second finishing contractor was employed to finish the staircase.

12.18. THE STRUCTURAL EXAMPLE

The initial structural proposal, as submitted to the Building Control division in the original submission, was to reinforce the existing roof structure with 170x38mm SC3 grade timber.[465] This information was derived from British Standard structural tables for domestic loading situations[466] that specify the timber grade and dimensions for providing an adequate structural platform for domestic housing.

12.18.1. 10 November 2005

We had been advised to submit the Building Warrant application without a Structural Engineer. As this was a domestic renovation it was considered likely that they would accept the domestic loading figures from the previously mentioned British Standard tables.

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[463] ‘Pitch’ is a term indicating the angle that the staircase rises from the ground at. As the height and depth of staircase steps have an acceptable range, the pitch of a staircase may vary but cannot exceed 42 degrees. The staircase purchased had a pitch of 42 degrees.

[464] ‘Riser’ refers to the height of each step. The risers must be consistent for the entire staircase.

[465] See Appendix A.5, Section 17.1, drawing AL-BC/09, general note on left-hand side under ‘floors’.

[466] BS 5268 For structural timber loading

This however did not prove to be the case, and in the response[467] from Building Control they requested 4 items of structural clarification. A list of potential Structural Engineers was obtained via personal recommendation from architects known to the author. These Engineers were then contacted for an expression of interest in tendering for the structural aspect of this project. Engineers that expressed interests were forwarded a copy of the drawings and asked to return a quotation for providing the Building Warrant structural drawing package.

12.18.2. 16 December 2005

Structural Engineer was appointed, and they confirmed that the Building Warrant document package could be complete and submitted to the Building Control Division before it closed for Christmas.

12.18.3. 20 December 2005

The supplemental information as identified in the Building Control correspondence of 10th November 2005, was forwarded to the Officer in charge on 20th December 2005,[468] along with the contact information for the appointed Structural Engineer.

12.18.4. 9th January 2006

The structural drawing package was not submitted to the Building Control Division before Christmas, it is submitted to the architect on this date, having been submitted to Building Control a few days previous. The architect forwarded it to the contractor immediately.

The proposed solution actually uses smaller—and thus cheaper—timber than had been originally specified, but the Structural Engineers fee negated any potential saving. There was some ambiguity regarding structural solution and the esoteric language used, the Engineer was contacted for clarification.

12.18.5. 11 January 2006

Findings on site, as the contractor removes the existing floor in the roof space to expose the existing structure, reveals that the structural solution is unachievable. The contractor is irate and contacts the architect as this continues to cause delays that had not been anticipated.

The Structural Engineer is contacted the following morning and contacts the contractor directly, it is agreed that the engineer will visit site that afternoon, at which point the Engineer gives the contractor specific instructions to enable them to proceed with a viable structural solution.

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[467] See Appendix A.5, Correspondence 001_r_002, point ‘b’.

[468] See Appendix A.5, correspondence 001_s_001

12.18.6. 13 January 2006

The Engineer contacts the architect in the morning to revise the instructions given to the contractor the previous evening. Rather than the new structural members being mechanically fixed to the existing timbers as the Engineer had instructed on the evening of the 12th, they had reconsidered and were proposing that the new timbers remain unattached to the existing timbers.

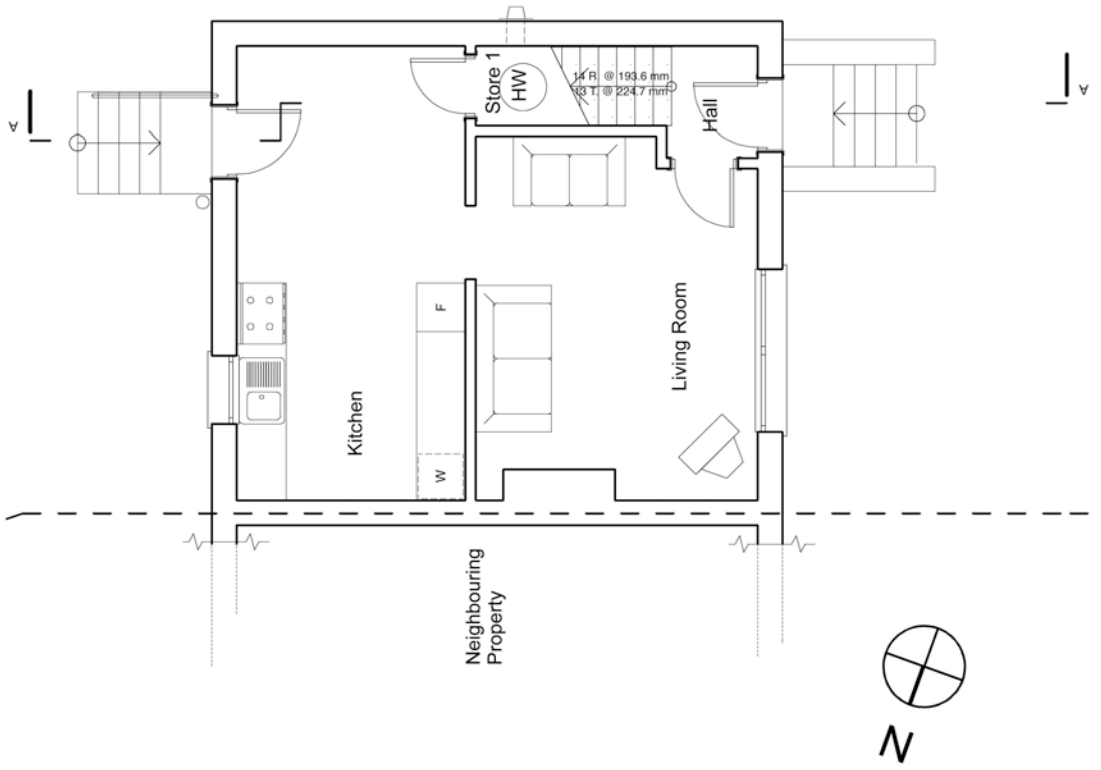
The contractor was contacted immediately and informed of this, although no work had yet been affected, the contractor was somewhat frustrated, mostly because this final solution as proposed by the Engineer, had been suggested the previous evening by the contractor at the site meeting with the Structural Engineer, and at that time it had been dismissed.

This was the final modification, the contractor was now able to proceed with the structural solution and in time the Structural Engineer inspected and approved that the structural work was completed to their satisfaction.

13. APPENDIX A-4: DRAWINGS

The drawings used for approval and construction during the roof space conversion.

13.1. FIRST BUILDING WARRANT SUBMISSION



Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Existing First Floor
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
1 : 50
Project Number
001/05
Drawing Number
AL-BC/02
Revision
variablefrog@gmail.com
variablefrog
A
A
13 R. @ 193.6 mm
13 T. @ 224.7 mm
Upper Landing
Store 2
Store 3
Bedroom 1
Bedroom 2
N

Revision By Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
Existing Roofspace

Drawing Status
Building Control Submission

Drawn by D.McMeel | Date August 05 | Checked by D.McMeel

Scales 1 : 50

Project Number **001/05** | Drawing Number **AL-BC/03** | Revision

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Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Existing Roof Plan
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
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Drawing Number
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variablefrog@gmail.com
variablefrog
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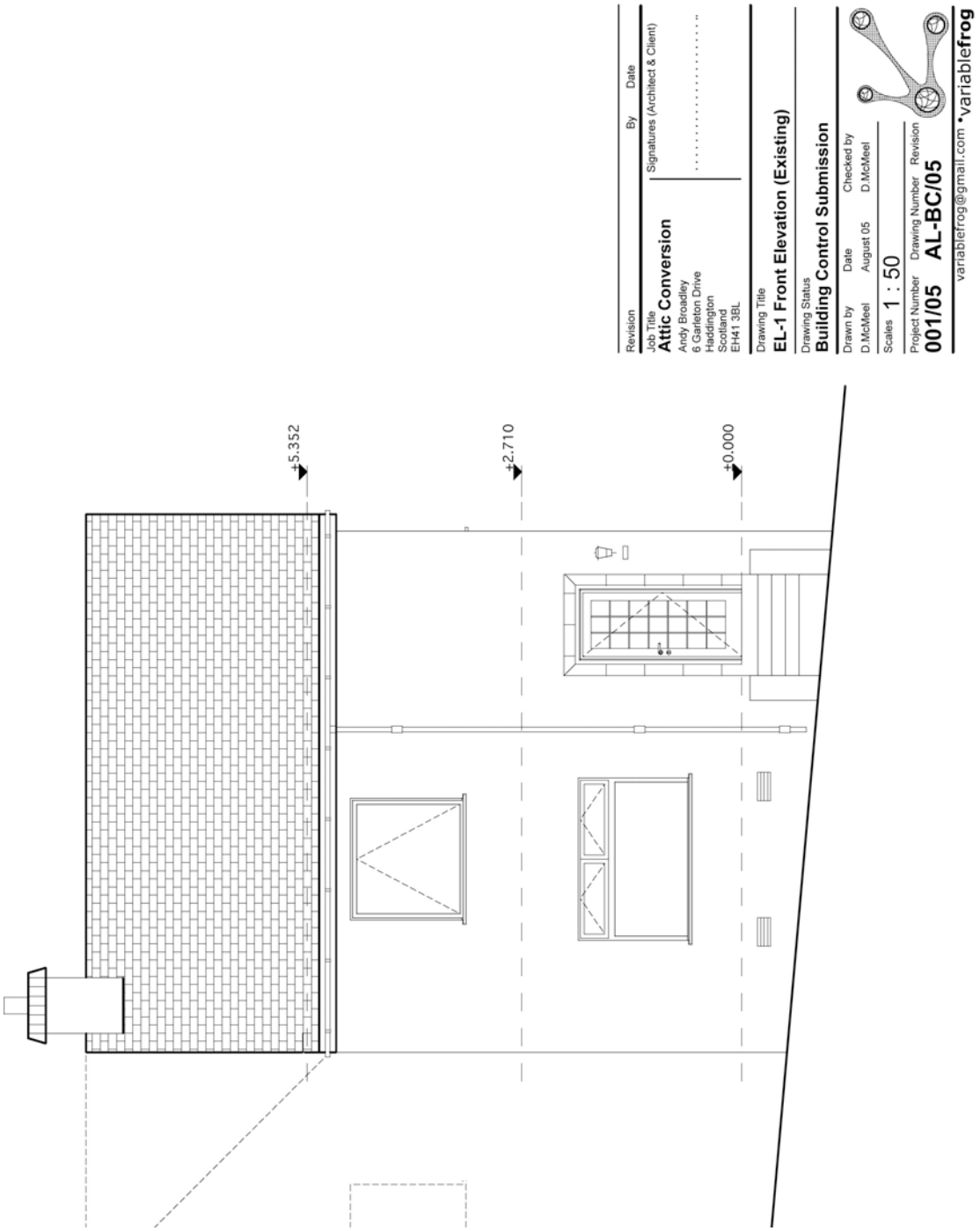
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±0.000
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By
Date
Job Title
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Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
EL-1 Front Elevation (Existing)
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
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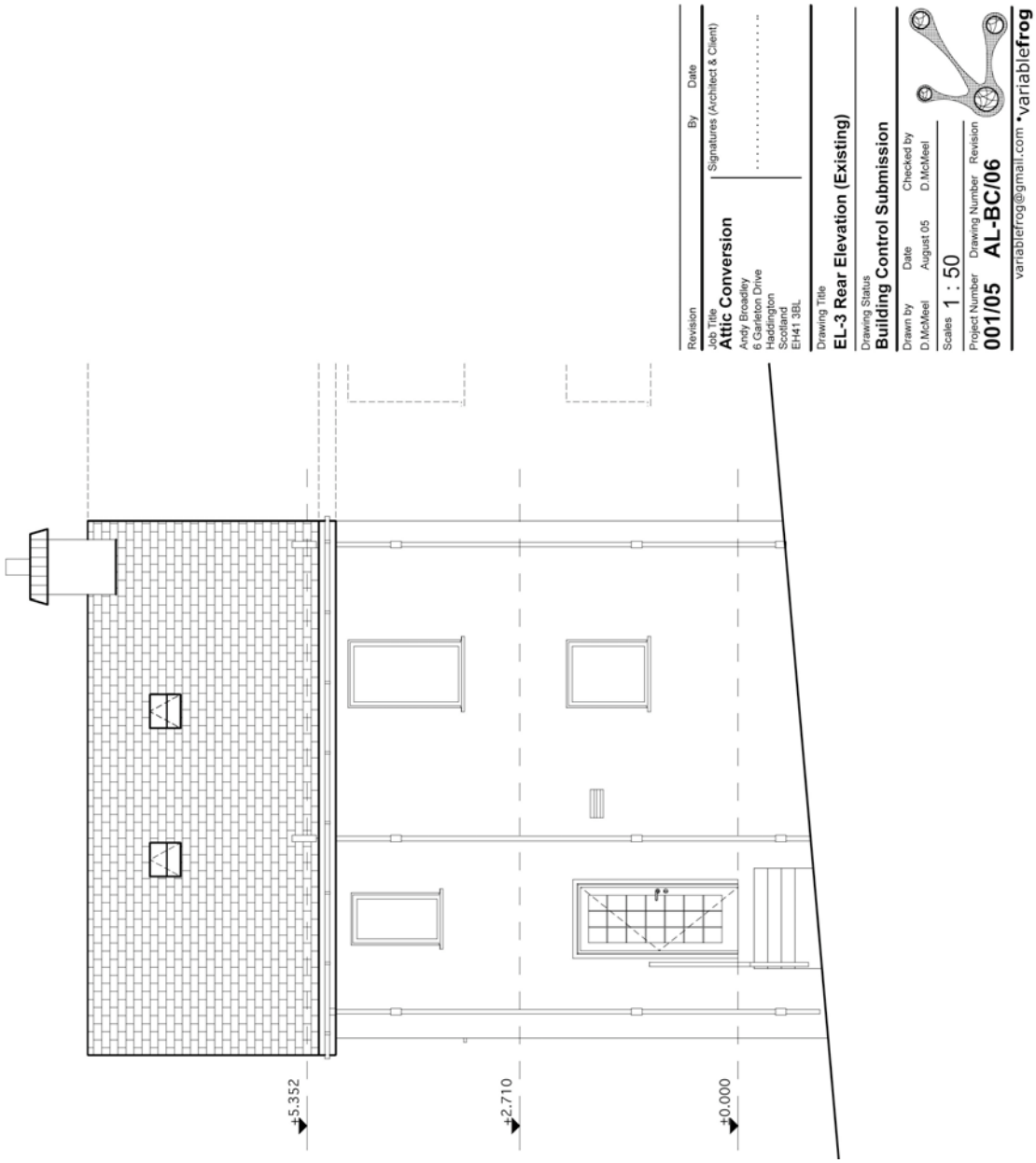
Drawing Number
AL-BC/05
Revision
variablefrog@gmail.com
variablefrog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Revision By Date
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Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
EL-3 Rear Elevation (Existing)
Drawing Status
Building Control Submission
Drawn by D.McMeel
Date August 05
Checked by D.McMeel
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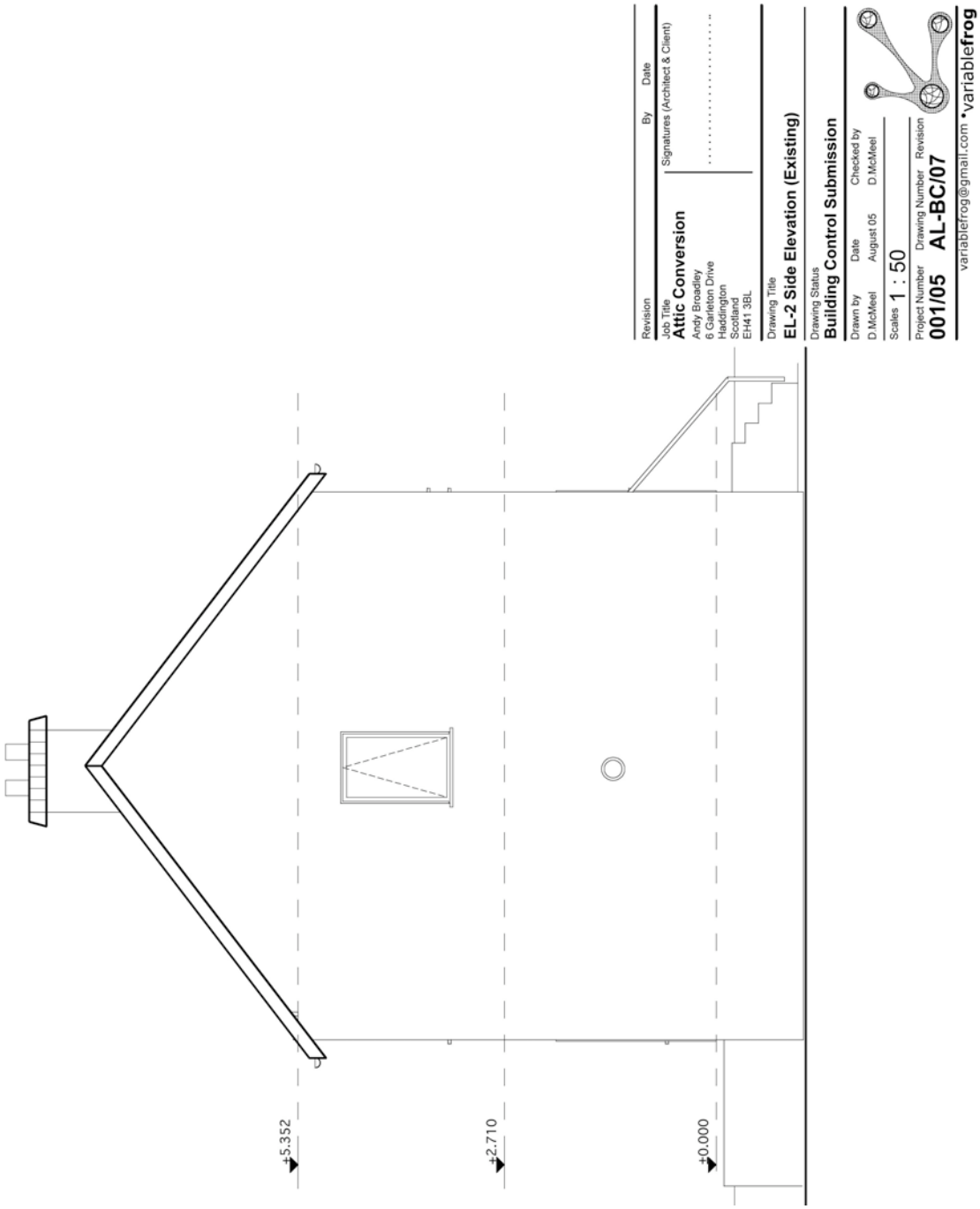
Drawing Number AL-BC/06
Revision
variablefrog@gmail.com variablefrog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Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
EL-2 Side Elevation (Existing)
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
1 : 50
Project Number
001/05
Drawing Number
AL-BC/07
Revision
variablefrog@gmail.com
variablefrog

NOTES

WALLS
STUD: 100X50MM TIMBERS AT 450MM CENTRES WITH 12.5MM GYPSUM PLASTERBOARD SHEETS FIXED AS PER MANUFACTURERS SPEC. BONDED AND SKIMMED AND PREPARED FOR DECORATIVE PAINTED FINISH TO MATCH EXISTING

FLOORS
TO COMPLY WITH BS 5268
EXISTING LOFT FLOOR TO BE REINFORCED WITH 170X38MM SC3 GRADE TIMBER JOIST AT MAX. 450MM CENTRES. PLYWOOD DECKED.
TIMBER FLOOR TO ARCHITECTS SPECIFICATION. USE A WATER RESISTANT SYSTEM IN WET AREAS

WINDOWS
VELUX SKYLIGHT TO ARCHITECTS SPECIFICATION INSTALLED TO MANUFACTURERS RECOMMENDATION WITH TRICKLE VENTILATOR
TO COMPLY WITH APPROVED DOCUMENT B (2000) FOR ESCAPE AND DOCUMENT F FOR VENTILATION

BATHROOM
USE MOISTURE RESISTANT PLASTERBOARD ON INNER WALL LINING AND FINISH WITH MOISTURE RESISTANT PAINT

TILING
TILES AND GROUT TO ARCHITECT SPECIFICATIONS. USE WATERPROOF TILE ADHESIVE AND WATER RESISTANT GROUT

FIRE
SMOKE ALARM TO BE FITTED TO THE TOP LANDING SHOULD BE MAINS OPERATED AND COMPLY WITH BS 5446
NEW STAIR WALLS SHOULD PROVIDE 30MIN FIRE RESISTANCE
DOORS LEADING OF THE STAIRS ON THE TOP FLOOR TO BE FITTED WITH RISING BUTT HINGES AND PROVIDE 20MIN FIRE RESISTANCE

DRAINAGE AND WASTE
FITTINGS TO ARCHITECTS SPECIFICATION
NEW SANITRY FITTING TO TIE INTO EXISTING. TO COMPLY WITH APPROVED DOCUMENT H AND BS EN 12056-2

ELECTRICAL
SWITCHES AND SOCKETS TO ARCHITECT SPECIFICATION TO COMPLY WITH BS 1363
WIRING TO COMPLY WITH BS 7671

STAIRS
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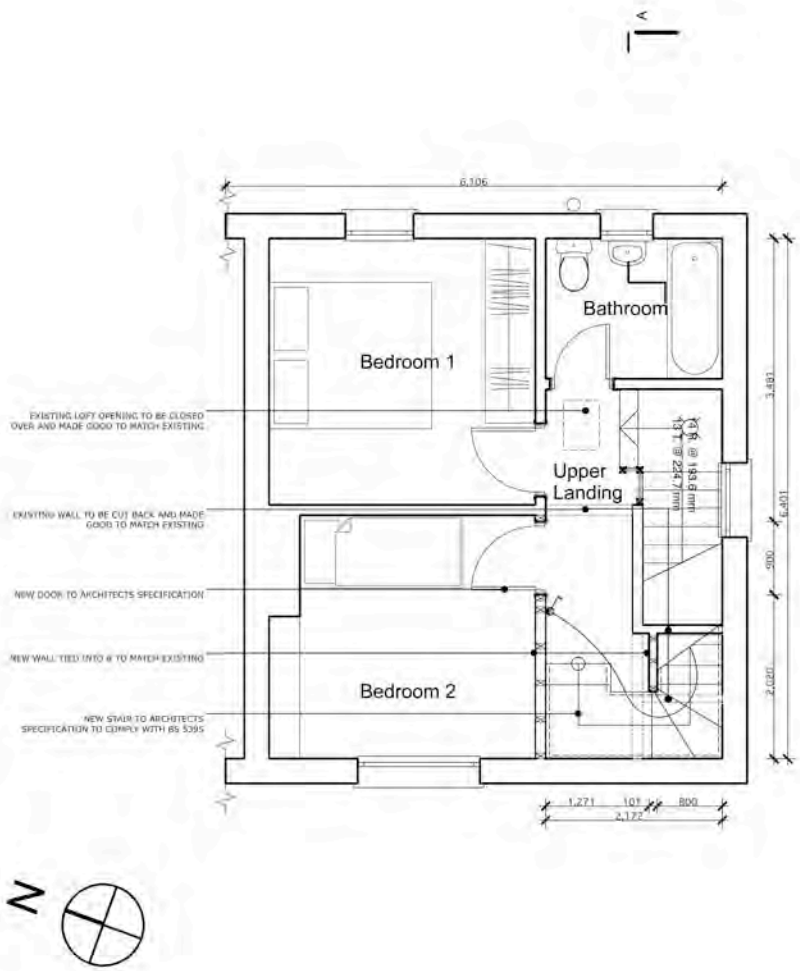
13 RISERS AT 205.5MM
12 THREAD AT 259MM
MIN CLEAR WIDTH 800MM TO COMPLY WITH BS 5395



Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
Proposed First Floor

Drawing Status
Building Control Submission

Drawn by	Date	Checked by
D McMeel	August 05	D McMeel

Scales 1 : 50

Project Number	Drawing Number	Revision
001/05	**AL-BC/08**	

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NOTES

WALLS
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FLOORS
TO COMPLY WITH BS 5268
EXISTING LOFT FLOOR TO BE REINFORCED WITH 170X38MM SC3 GRADE TIMBER JOIST AT MAX. 450MM CENTRES. PLYWOOD DECKED
TIMBER FLOOR TO ARCHITECTS SPECIFICATION, USE A WATER RESISTANT SYSTEM IN WET AREAS

WINDOWS
VELUX SKYLIGHT TO ARCHITECTS SPECIFICATION INSTALLED TO MANUFACTURERS RECOMMENDATION WITH TRICKLE VENTILATOR
TO COMPLY WITH APPROVED DOCUMENT B (2000) FOR ESCAPE AND DOCUMENT F FOR VENTILATION

BATHROOM
USE MOISTURE RESISTANT PLASTERBOARD ON INNER WALL LINING AND FINISH WITH MOISTURE RESISTANT PAINT

TILING
TILES AND GROUT TO ARCHITECT SPECIFICATIONS. USE WATERPROOF TILE ADHESIVE AND WATER RESISTANT GROUT

FIRE
SMOKE ALARM TO BE FITTED TO THE TOP LANDING SHOUD BE MAINS OPERATED AND COMPLY WITH BS 5446
NEW STAIR WALLS SHOULD PROVIDE 30MIN FIRE RESISTANCE
DOORS LEADING OF THE STAIRS ON THE TOP FLOOR TO BE FITTED WITH RISING BUTT HINGES AND PROVIDE 20MIN FIRE RESISTANCE

DRAINAGE AND WASTE
FITTINGS TO ARCHITECTS SPECIFICATION
NEW SANITRY FITTING TO TIE INTO EXISTING, TO COMPLY WITH APPROVED DOCUMENT H AND BS EN 12056-2

ELECTRICAL
SWITCHES AND SOCKETS TO ARCHITECT SPECIFICATION
TO COMPLY WITH BS 1363
WIRING TO COMPLY WITH BS 7671

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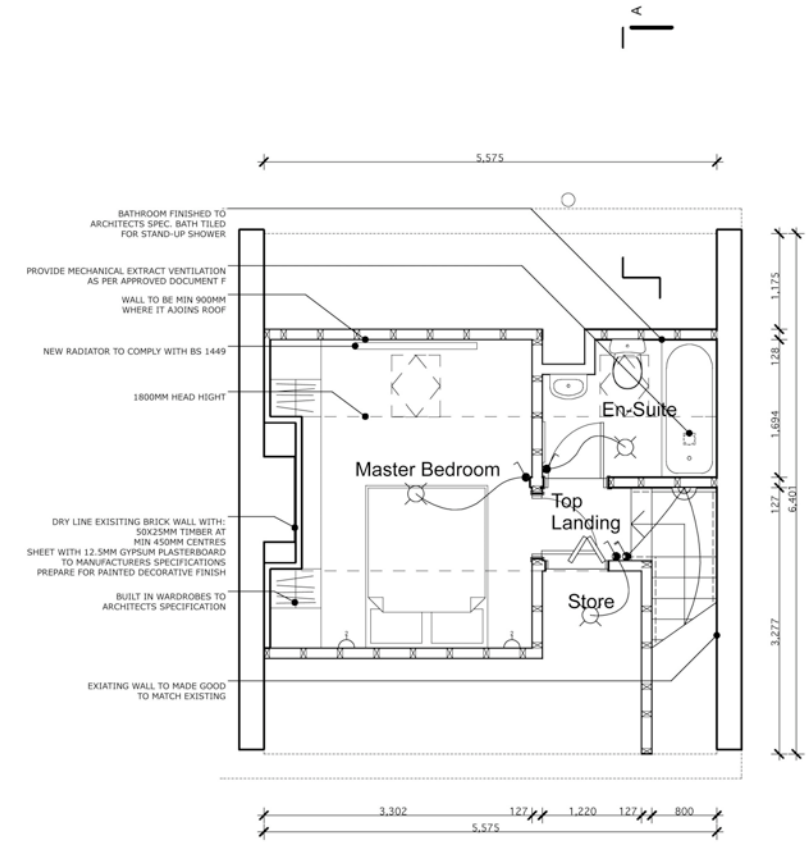

Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)
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Drawing Title
Proposed Loft

Drawing Status
Building Control Submission

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scales 1 : 50

Project Number	Drawing Number	Revision
001/05	**AL-BC/09**	

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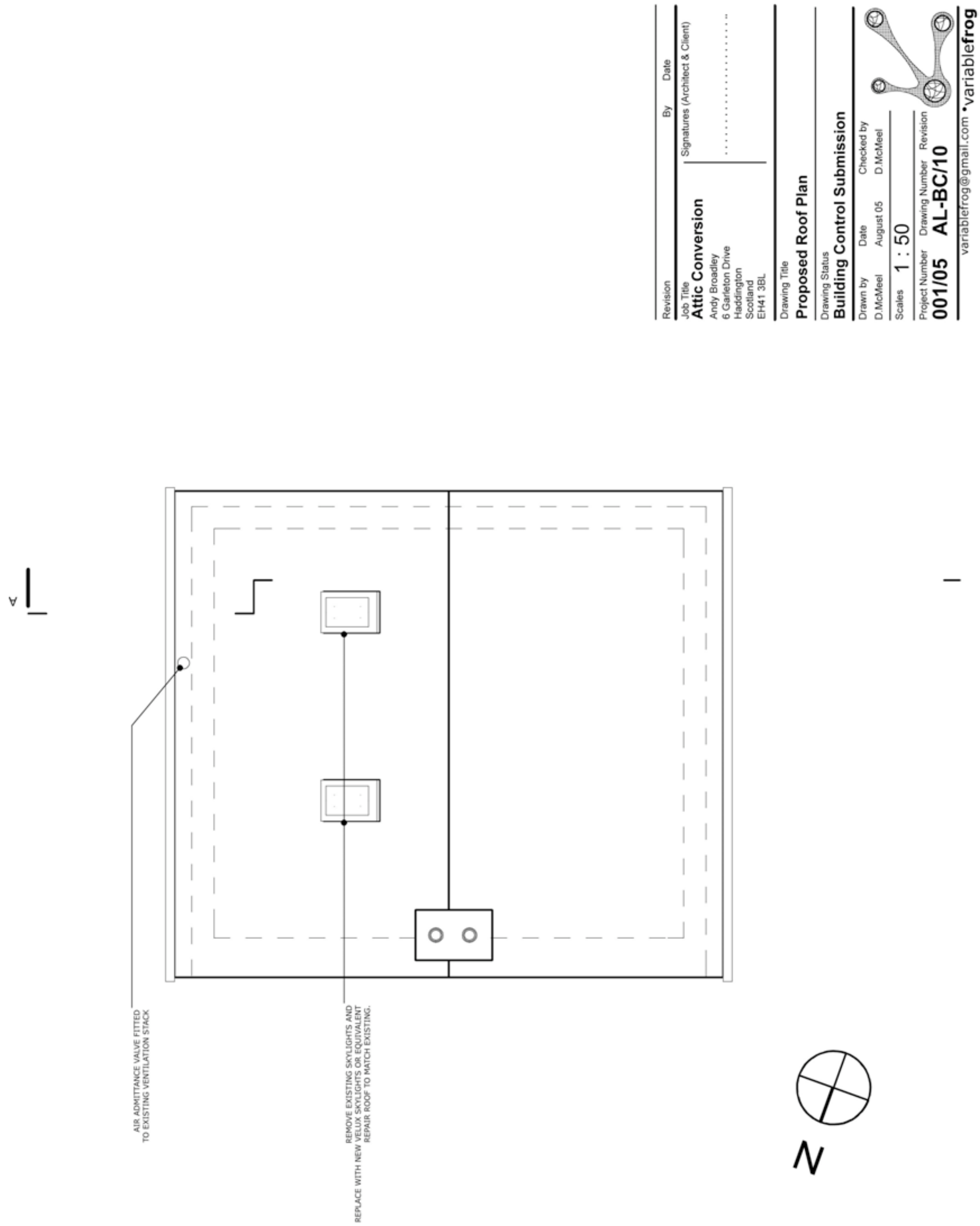
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By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
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Drawing Status
Building Control Submission
Drawn by
Date
Checked by
D.McMeel
August 05
D.McMeel
Scales
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Project Number
Drawing Number
Revision
001/05
AL-BC/10
variablefrog@gmail.com
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AIR ADMITTANCE VALVE FITTED TO EXISTING VENTILATION STACK
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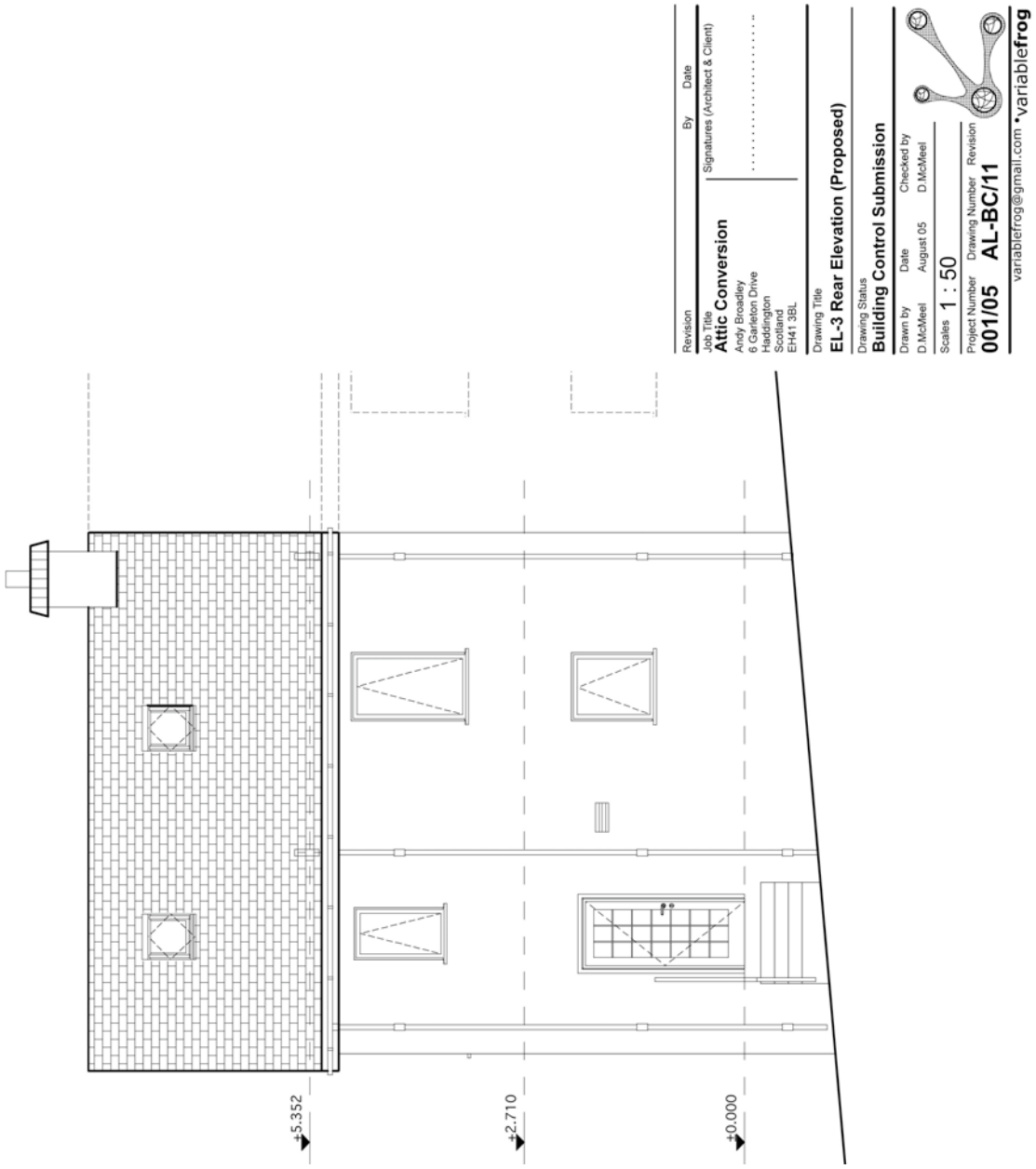
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Job Title
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Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
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EL-3 Rear Elevation (Proposed)
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
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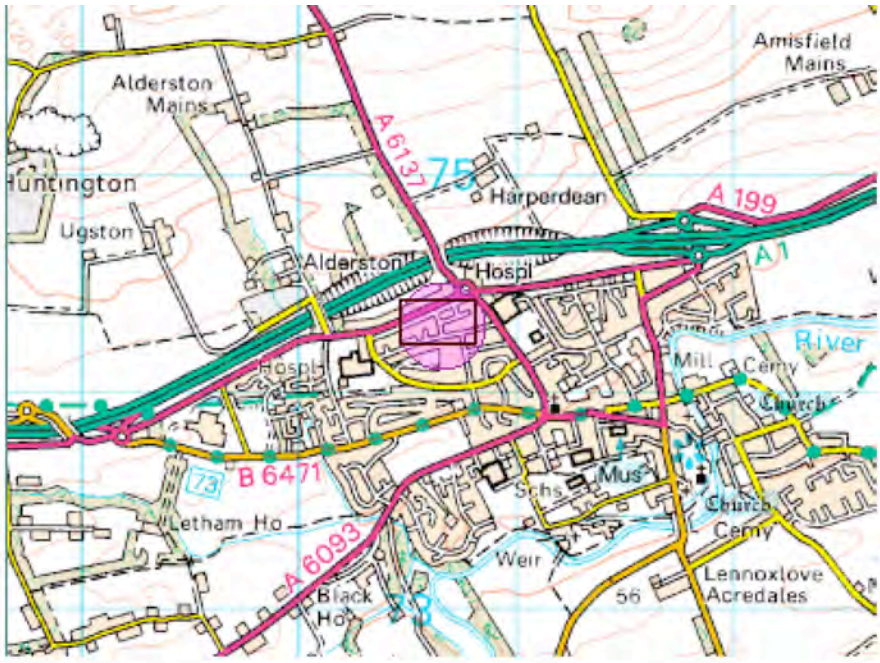

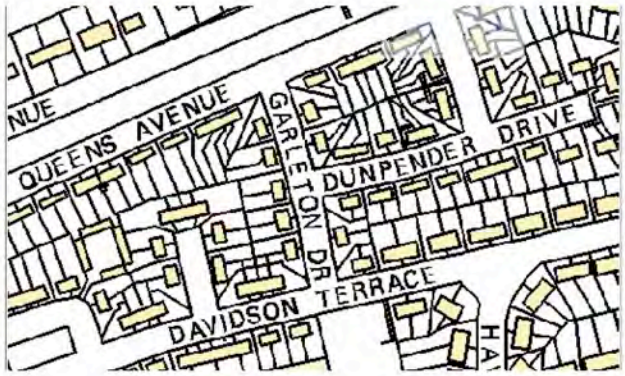

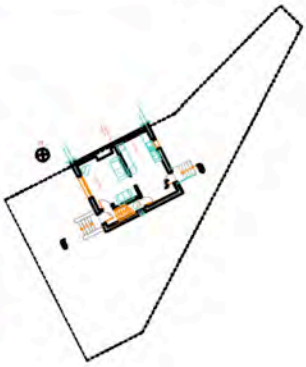

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Building Control Submission

Revision	By	Date

Job Title

Attic Conversion

6 Garleton Drive
Haddington
Scotland
EH41 3BL

Drawing Title

Location Plan

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scale **As Shown**

Project Number	Drawing Number	Revision
001/05	**AL-BC/12**	

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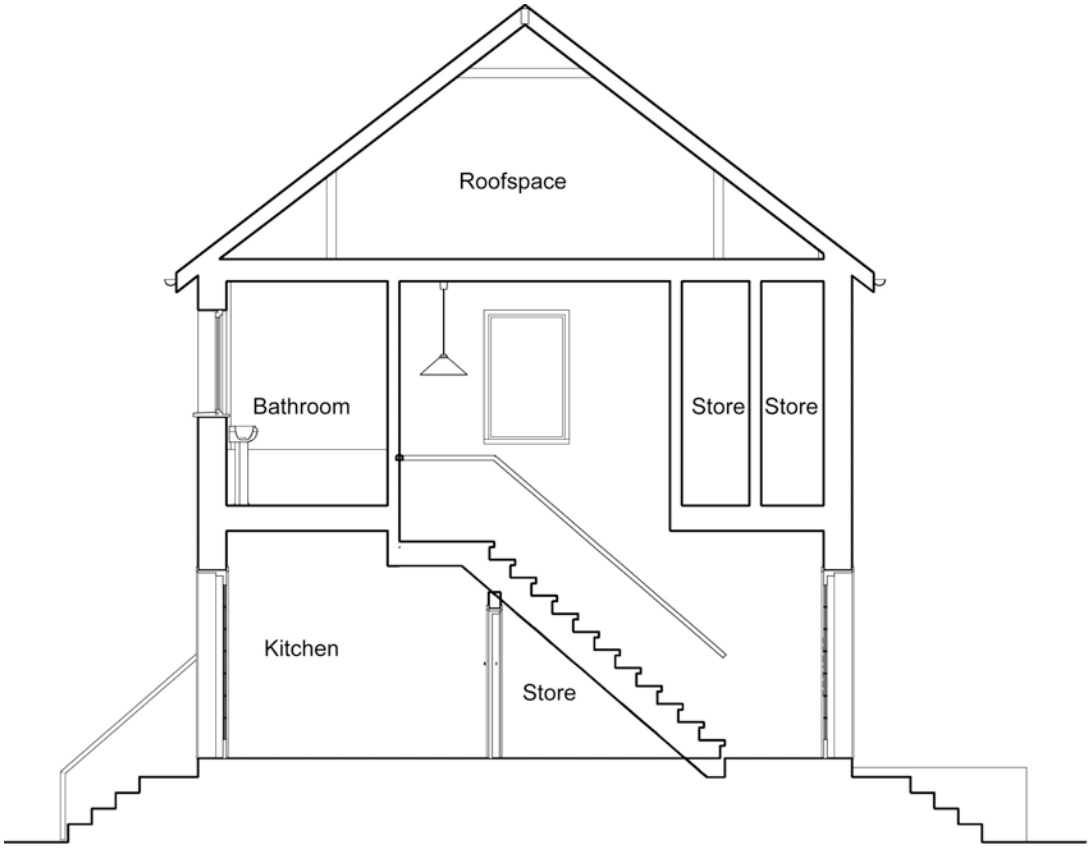

Revision	By	Date

Job Title
Attic Conversion

Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

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Drawing Title
Exising Section A-A

Drawing Status
Building Control Submission

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D.McMeel	August 05	D.McMeel

Scales 1 : 50

Project Number	Drawing Number	Revision
001/05	**AL-BC/13**	

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NOTES

WALLS
STUD: 100X50MM TIMBERS AT 450MM CENTRES WITH 12.5MM GYPSUM PLASTERBOARD SHEETS FIXED AS PER MANUFACTURERS SPEC. BONDED AND SKIMMED AND PREPARED FOR DECORATIVE PAINTED FINISH TO MATCH EXISTING

FLOORS
TO COMPLY WITH BS 5268.
EXISTING LOFT FLOOR TO BE REINFORCED WITH 170X38MM SC3 GRADE TIMBER JOIST AT MAX. 450MM CENTRES. PLYWOOD DECKED.
TIMBER FLOOR TO ARCHITECTS SPECIFICATION, USE A WATER RESISTANT SYSTEM IN WET AREAS

WINDOWS
VELUX SKYLIGHT TO ARCHITECTS SPECIFICATION INSTALLED TO MANUFACTURERS RECOMMENDATION WITH TRICKLE VENTILATOR
TO COMPLY WITH APPROVED DOCUMENT B (2000) FOR ESCAPE AND DOCUMENT F FOR VENTILATION

BATHROOM
USE MOISTURE RESISTANT PLASTERBOARD ON INNER WALL LINING AND FINISH WITH MOISTURE RESISTANT PAINT

TILING
TILES AND GROUT TO ARCHITECT SPECIFICATIONS. USE WATERPROOF TILE ADHESIVE AND WATER RESISTANT GROUT

FIRE
SMOKE ALARM TO BE FITTED TO THE TOP LANDING SHOULD BE MAINS OPERATED AND COMPLY WITH BS 5446
NEW STAIR WALLS SHOULD PROVIDE 30MIN FIRE RESISTANCE
DOORS LEADING OF THE STAIRS ON THE TOP FLOOR TO BE FITTED WITH RISING BUTT HINGES AND PROVIDE 20MIN FIRE RESISTANCE

DRAINAGE AND WASTE
FITTINGS TO ARCHITECTS SPECIFICATION
NEW SANITRY FITTING TO TIE INTO EXISTING. TO COMPLY WITH APPROVED DOCUMENT H AND BS EN 12056-2

ELECTRICAL
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TO COMPLY WITH BS 1363.
WIRING TO COMPLY WITH BS 7671

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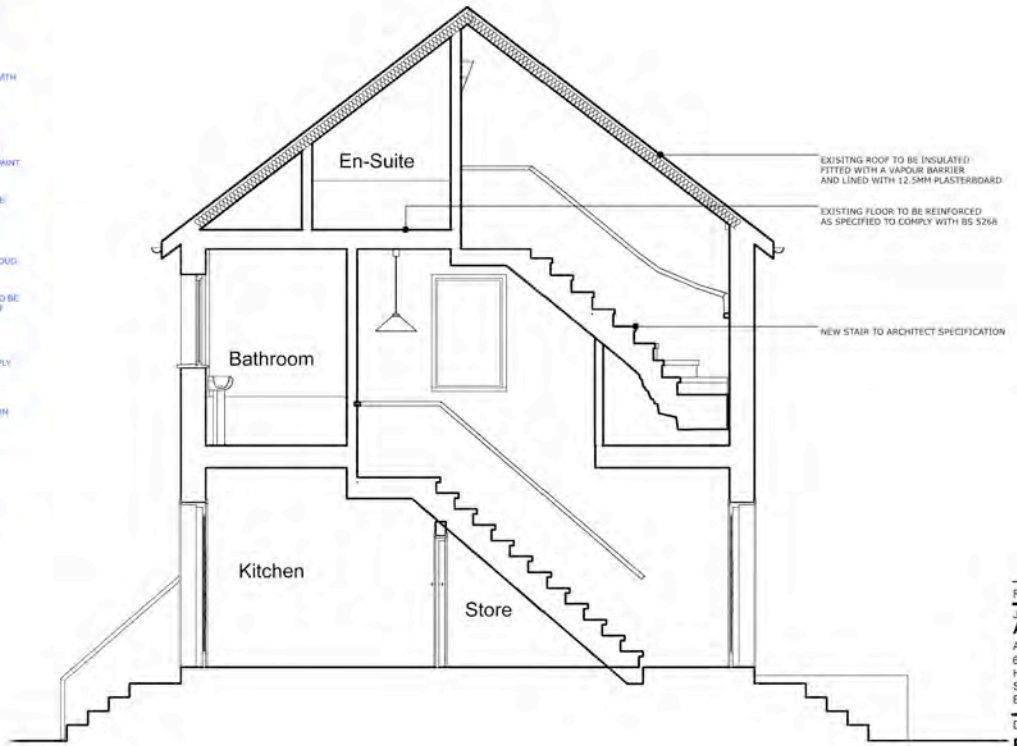

Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)
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Drawing Title
Proposed Section A-A

Drawing Status
Building Control Submission

Drawn by	Date	Checked by
D McMeel	August 05	D McMeel

Scale 1 : 50

Project Number	Drawing Number	Revision
001/05	AL-BC/14	

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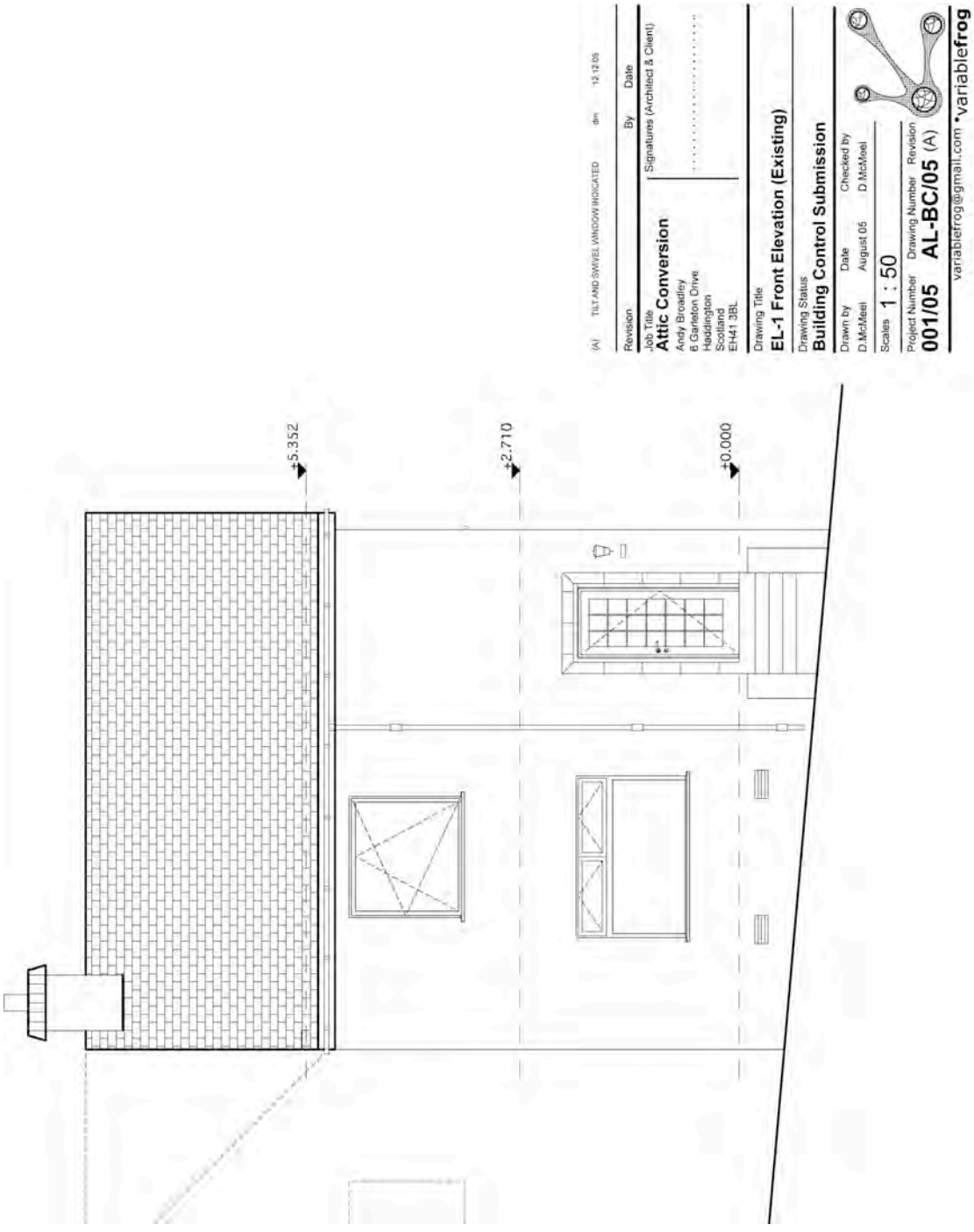
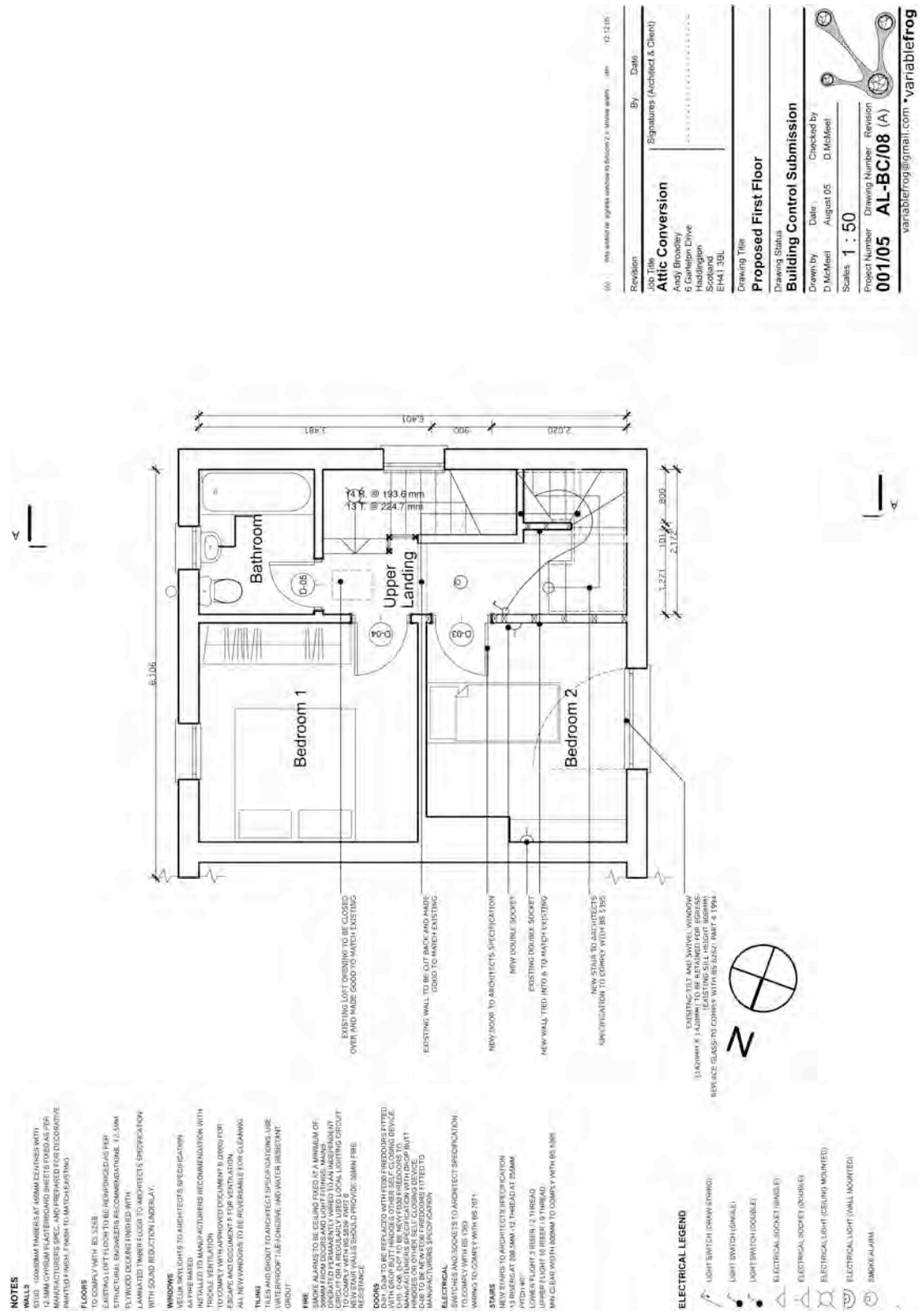
13.2. SECOND BUILDING WARRANT SUBMISSION

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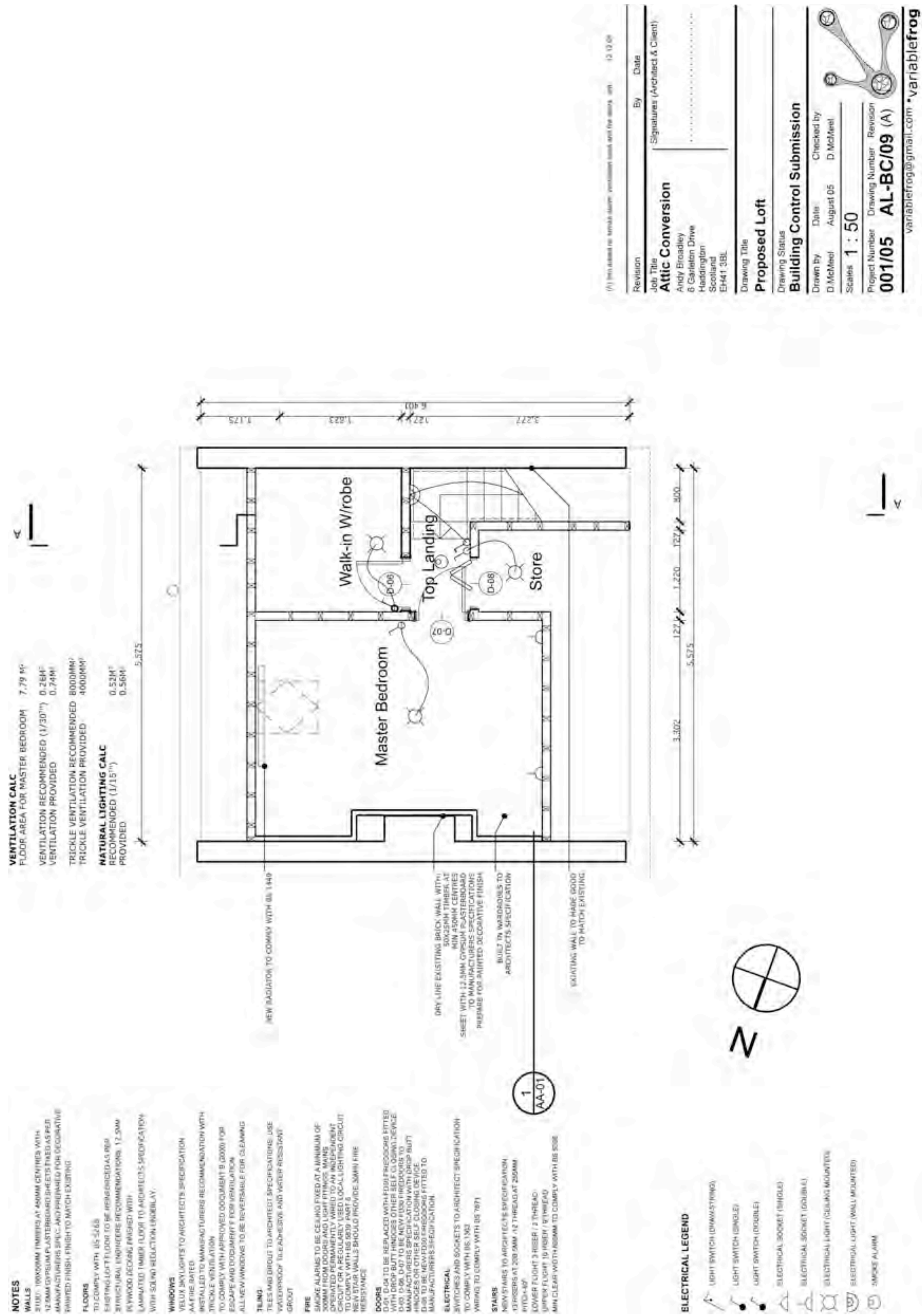
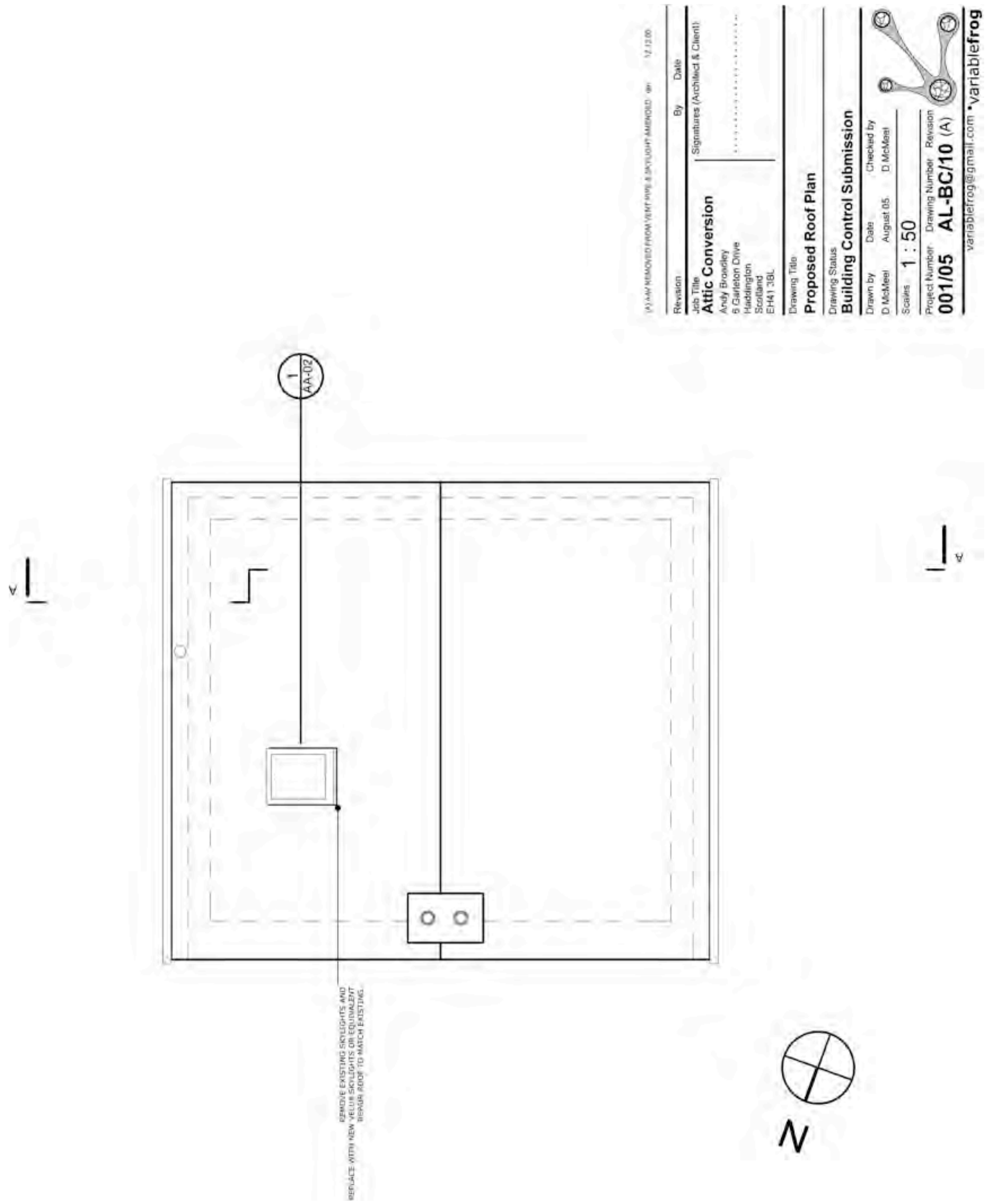
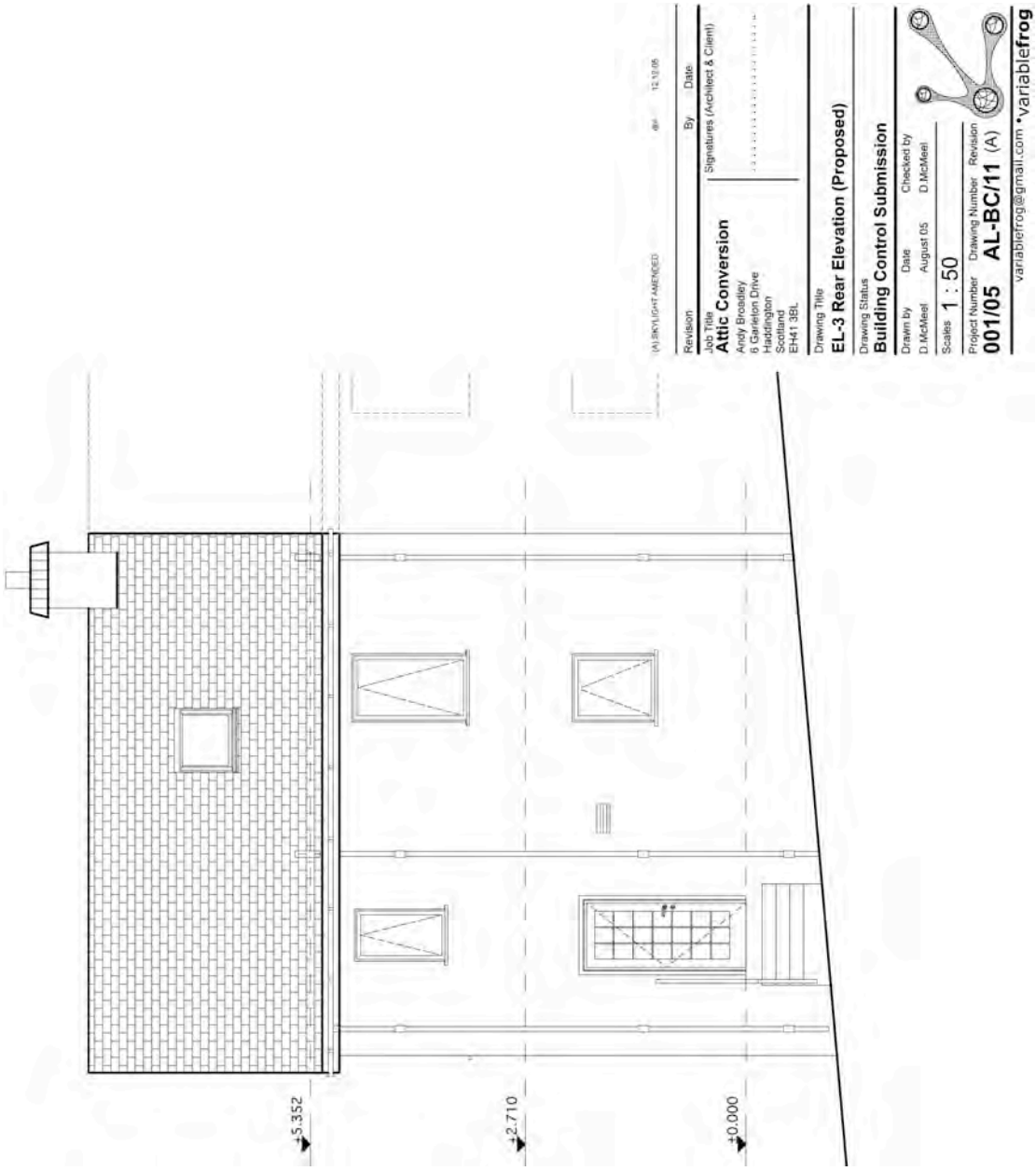
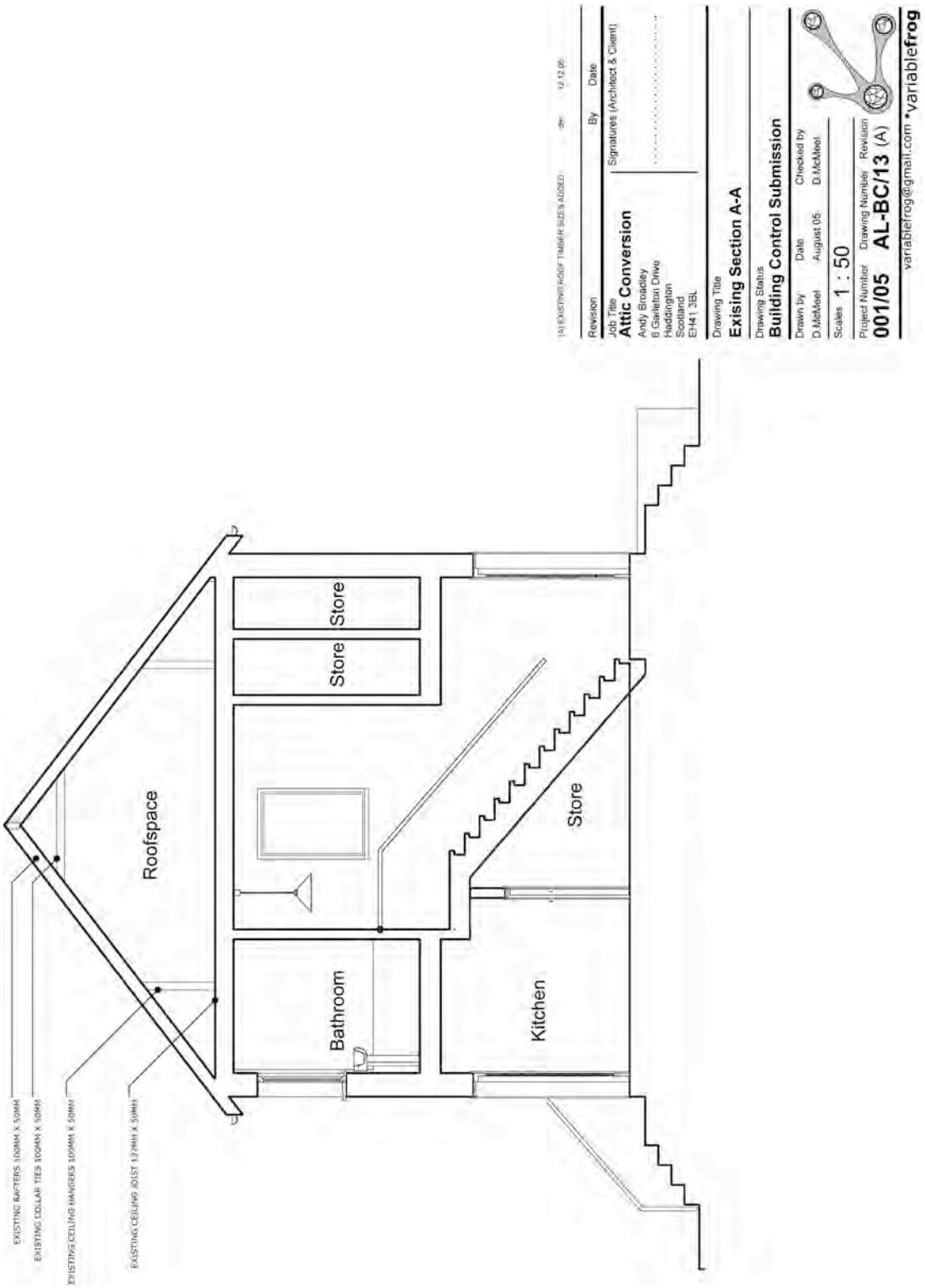
FLOORS
TO COMPLY WITH BS 5268
EXISTING LOFT FLOOR TO BE REINFORCED AS PER STRUCTURAL ENGINEERS RECOMMENDATIONS. 15.0MM PLYWOOD DECKING FINISHED WITH LAMINATED TIMBER FLOOR TO ARCHITECTS SPECIFICATION WITH SOUND REDUCTION UNDERLAY.
WINDOWS
VELUX SKYLIGHTS TO ARCHITECTS SPECIFICATION
AS PER PLANS
INSTALLED TO MANUFACTURERS RECOMMENDATION WITH FLASHING KIT AND APPROVED DOCUMENT L
TO COMPLY WITH APPROVED DOCUMENT B (2000) PART E
ESCAPE AND EGGUMENT F FOR VENTILATION
ALL NEW WINDOWS TO BE REVERSABLE FOR CLEANING
TILING
TILING AND GROUT TO ARCHITECTS SPECIFICATIONS. USE WATERPROOF TILE ADHESIVE AND WATER RESISTANT GROUT
FIRE
SMOKE ALARMS TO BE CEILING FIXED (1 x MINIMUM OF SMOKE ALARM TO EACH FLOOR) AND INTERLINKED AND DIGRATED PERMANENTLY WIRED TO AN INDEPENDENT CIRCUIT OR A REGULARLY USED LOCAL LIGHTING CIRCUIT
TO COMPLY WITH BS 5839 PART 6
NEW STAIR WALLS SHOULD PROVIDE 30MIN FIRE RESISTANCE
DOORS
DOOR TO BE REPLACED WITH FD30 FIREDOOR IS FITTED WITH DEUR BUTT HINGES OTHER SELF CLOSING DEVICE
D.01, D.02, D.04 TO BE NEW FD30 FIREDOORS TO
D.03, D.05, D.06 TO BE NEW DOORS WITH DEUR BUTT HINGES OR OTHER SELF CLOSING DEVICE
DUE TO BE NEW FD30 FIREDOORS FITTED TO MANUFACTURERS SPECIFICATION
ELECTRICAL
SWITCHES AND SOCKETS TO ARCHITECT SPECIFICATION TO COMPLY WITH BS 1363
WIRING TO COMPLY WITH BS 7671
STAIRS
NEW STAIRS TO ARCHITECTS SPECIFICATION
13 RISERS AT 186.5MM / 12 THREAD AT 250MM
PITCH 40°
LOWER FLIGHT 3 RISER / 2 THREAD
UPPER FLIGHT 10 RISER / 9 THREAD
MIN CLEAR WIDTH 800MM TO COMPLY WITH BS 5395
ELECTRICAL LEGEND
LIGHT SWITCH (DRAW STRING)
LIGHT SWITCH (SINGLE)
LIGHT SWITCH (DOUBLE)
ELECTRICAL SOCKET (SINGLE)
ELECTRICAL SOCKET (DOUBLE)
ELECTRICAL LIGHT (CEILING MOUNTED)
ELECTRICAL LIGHT (WALL MOUNTED)
SMOKE ALARM
A
A
6.106
3.481
900
2.020
6.401
14 @ 193.6 mm
13 T. @ 224.7 mm
Bathroom
Upper Landing
Bedroom 1
Bedroom 2
D.06
D.04
D.03
D.05
1.221
101
800
2.112
EXISTING LOFT OPENING TO BE CLOSED OVER AND MADE GOOD TO MATCH EXISTING
EXISTING WALL TO BE CUT BACK AND MADE GOOD TO MATCH EXISTING
NEW DOOR TO ARCHITECTS SPECIFICATION
NEW DOUBLE SOCKET
EXISTING DOUBLE SOCKET
NEW WALL TIED INTO & TO MATCH EXISTING
NEW STAIR TO ARCHITECTS SPECIFICATION TO COMPLY WITH BS 5395
EXISTING TILT AND SWIVEL WINDOW (1140mm W. 1420MM T) TO BE RETAINED FOR ESCAPE PURPOSES. REPLACE GLASS TO COMPLY WITH BS 6262: PART 4 1994
N
(A) Velux added rear skylights window as Velux 2 x window alarm dm 12.12.05
Revision By Date
Job Title
Attic Conversion
Andy Broadley
6 Garfellon Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Proposed First Floor
Drawing Status
Building Control Submission
Drawn by D.McMeel
Date : August 05
Checked by D.McMeel
Scales 1 : 50
Project Number 001/05
Drawing Number AL-BC/08 (A)
Revision
variablefrog@gmail.com variablefrog

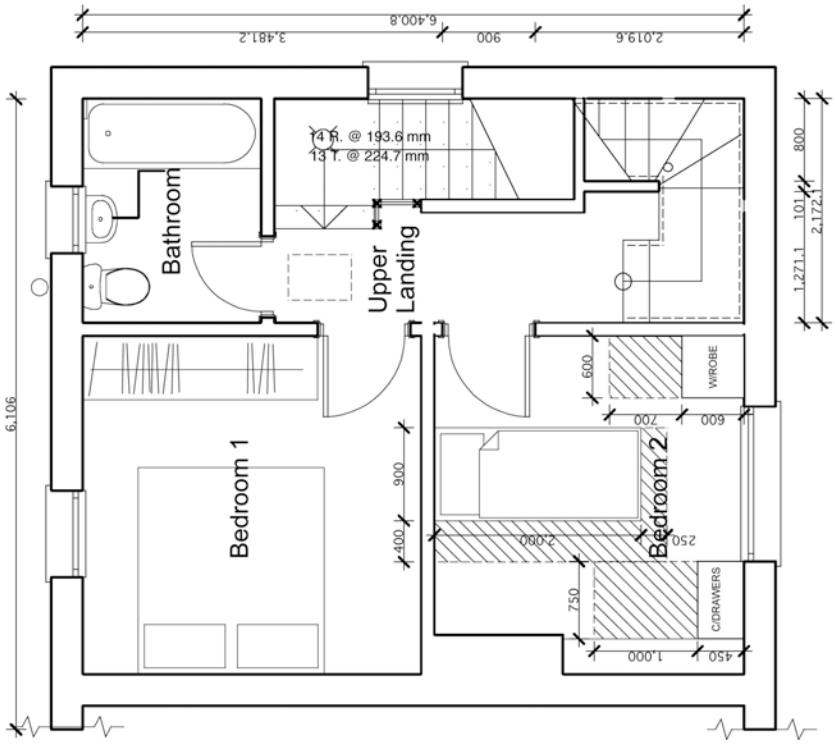

Attic Conversion
Andy Broadley
8 Garleton Drive
Haddington
Scotland
EH41 3BL
Proposed Loft
Building Control Submission
1 : 50
001/05
AL-BC/09 (A)
variablefrog@gmail.com
variablefrog
Master Bedroom
Walk-in W/robe
Top Landing
Store
NOTES
ELECTRICAL LEGEND
VENTILATION CALC
NATURAL LIGHTING CALC


Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Proposed Roof Plan
Drawing Status
Building Control Submission
Drawn by
D McMeel
Date
August 05
Checked by
D McMeel
Scales
1 : 50
Project Number
001/05
Drawing Number
AL-BC/10
Revision
(A)
variablefrog@gmail.com
•variablefrog
1
AA-02
A
A
REMOVE EXISTING SKYLIGHTS AND
REPLACE WITH NEW VELUX SKYLIGHTS OR EQUIVALENT
REPAIR ROOF TO MATCH EXISTING
N


+5.352
+2.710
±0.000
Revision
By
Date
(A) SKYLIGHT AMENDED
dbr
12.10.05
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
EL-3 Rear Elevation (Proposed)
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
1 : 50
Project Number
001/05
Drawing Number
AL-BC/11
Revision
(A)
variablefrog@gmail.com
variablefrog


EXISTING RAFTERS 100MM X 50MM
EXISTING COLLAR TIES 100MM X 50MM
EXISTING CEILING HANGERS 100MM X 50MM
EXISTING CEILING JOIST 127MM X 50MM
Roofspace
Store
Store
Store
Bathroom
Kitchen
(A) EXISTING ROOF TIMBER SIZES ADDED
Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Exising Section A-A
Drawing Status
Building Control Submission
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales 1 : 50
Project Number
001/05
Drawing Number
AL-BC/13
Revision
(A)
variablefrog@gmail.com
variablefrog

NOTES
WALLS
EXISTING ROOF TO BE INSULATED, FITTED WITH A VAPOUR BARRIER AND LINED WITH 12.5MM PLASTERBOARD
EXISTING FLOOR TO BE REINFORCED AS SPECIFIED TO COMPLY WITH BS 5268
NEW STAIR TO ARCHITECT SPECIFICATION
Walk-in W/robe
Bathroom
Kitchen
Store
ELECTRICAL LEGEND
LIGHT SWITCH (ONE WAY SWING)
LIGHT SWITCH (SINGLE)
LIGHT SWITCH (DOUBLE)
ELECTRICAL SOCKET (SINGLE)
ELECTRICAL SOCKET (DOUBLE)
ELECTRICAL LIGHT (CEILING MOUNTED)
ELECTRICAL LIGHT (WALL MOUNTED)
SMOKE ALARM
Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Gaileton Drive
Hedonington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
Proposed Section A-A
Drawing Status
Building Control Submission
Drawn by
D McMeel
Date
August 05
Checked by
D McMeel
Scale 1 : 50
Project Number
001/05
Drawing Number
AL-BC/14
Revision
(A)
variablefrog@gmail.com
variablefrog



Revision By Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
First Floor Space Standards

Drawing Status
Building Control Submission

Drawn by D.McMeel | Date August 05 | Checked by D.McMeel

Scales 1 : 50

Project Number **001/05** | Drawing Number **AL-BC/16** | Revision

variablefrog@gmail.com • variablefrog

NOTES

WALLS
STUD: 100X50MM TIMBERS AT 450MM CENTRES WITH
12.5MM GYPSUM PLASTERBOARD SHEETS FIXED AS PER
MANUFACTURERS SPEC. AND PREPARED FOR DECORATIVE
PAINTED FINISH, FINISH TO MATCH EXISTING

FLOORS
TO COMPLY WITH BS 5268
EXISTING LOFT FLOOR TO BE REINFORCED AS PER
STRUCTURAL ENGINEERS RECOMMENDATIONS. 12.5MM
PLYWOOD DECKING FINISHED WITH
LAMINATED TIMBER FLOOR TO ARCHITECTS SPECIFICATION
WITH SOUND REDUCTION UNDERLAY.

WINDOWS
VELUX SKYLIGHTS TO ARCHITECTS SPECIFICATION
AA FIRE RATED
INSTALLED TO MANUFACTURERS RECOMMENDATION WITH
TRICKLE VENTILATION
TO COMPLY WITH APPROVED DOCUMENT B (2000) FOR
ESCAPE AND DOCUMENT F FOR VENTILATION.
ALL NEW WINDOWS TO BE REVERSABLE FOR CLEANING

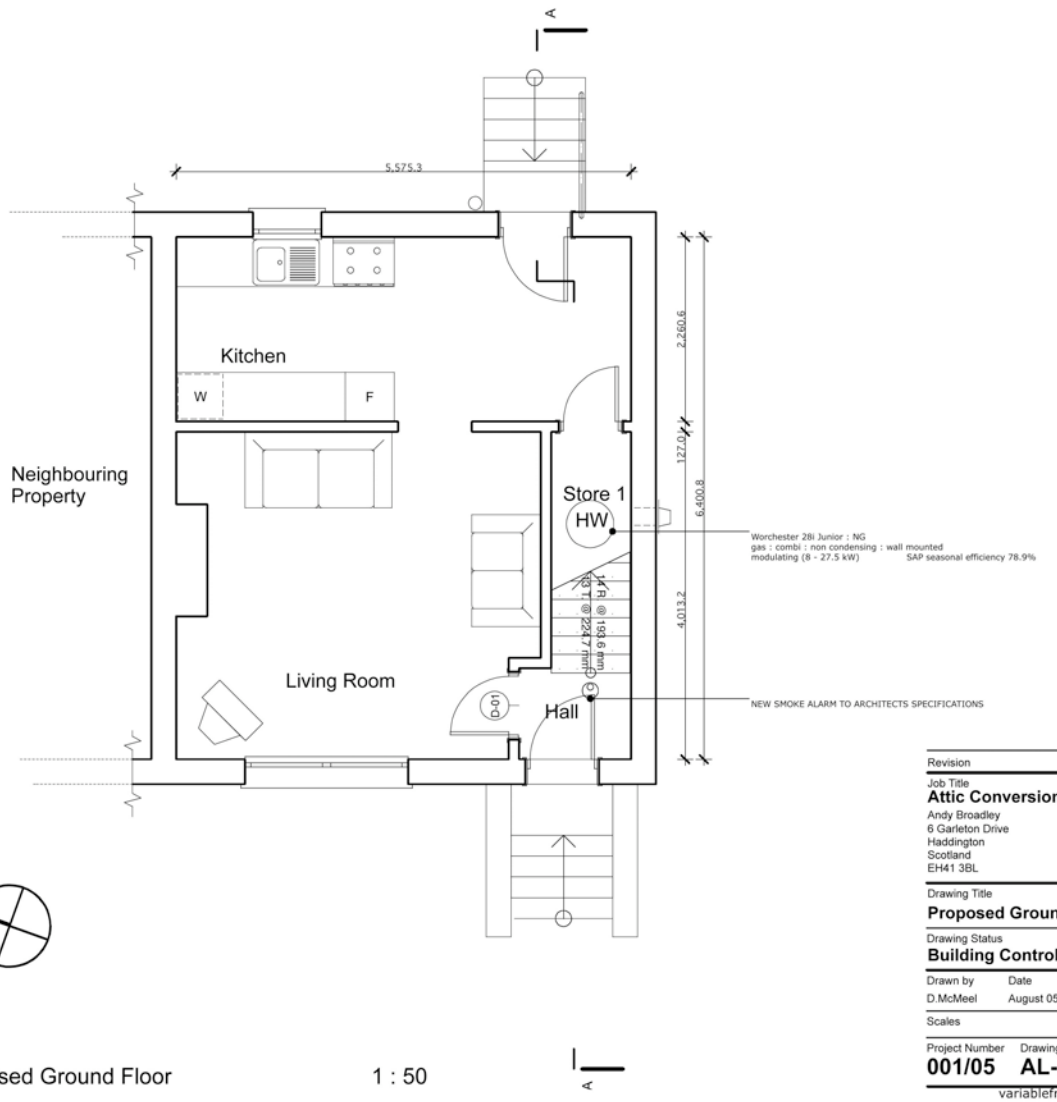
TILING
TILES AND GROUT TO ARCHITECT SPECIFICATIONS. USE
WATERPROOF TILE ADHESIVE AND WATER RESISTANT
GROUT

FIRE
SMOKE ALARMS TO BE CEILING FIXED AT A MINIMUM OF
300MM FROM DOORS AND LIGHT FITINGS. MAINS
OPERATED PERMANENTLY WIRED TO AN INDEPENDENT
CIRCUIT OR A REGULARLY USED LOCAL LIGHTING CIRCUIT
TO COMPLY WITH BS 5839: PART 6
NEW STAIR WALLS SHOULD PROVIDE 30MIN FIRE
RESISTANCE

DOORS
D-01, D-04 TO BE REPLACED WITH FD30 FIREDOORS FITTED
WITH DROP BUTT HINDGES OTHER SELF CLOSING DEVICE.
D-03, D-06, D-07 TO BE NEW FD30 FIREDOORS TO
MANUFACTURERS SPECIFICATION WITH DROP BUTT
HINDGES OR OTHER SELF CLOSING DEVICE.
D-08 TO BE NEW FD30 FIREDOORS FITTED TO
MANUFACTURERS SPECIFICATION

ELECTRICAL
SWITCHES AND SOCKETS TO ARCHITECT SPECIFICATION
TO COMPLY WITH BS 1363
WIRING TO COMPLY WITH BS 7671

STAIRS
NEW STAIRS TO ARCHITECTS SPECIFICATION.
13 RISERS AT 208.5MM -12 THREAD AT 255MM
PITCH 40°
LOWER FLIGHT 3 RISER / 2 THREAD
UPPER FLIGHT 10 RISER / 9 THREAD
MIN CLEAR WIDTH 800MM TO COMPLY WITH BS 5395.



ELECTRICAL LEGEND

- LIGHT SWITCH (DRAW STRING)
- LIGHT SWITCH (SINGLE)
- LIGHT SWITCH (DOUBLE)
- ELECTRICAL SOCKET (SINGLE)
- ELECTRICAL SOCKET (DOUBLE)
- ELECTRICAL LIGHT (CEILING MOUNTED)
- ELECTRICAL LIGHT (WALL MOUNTED)
- SMOKE ALARM

N

Proposed Ground Floor 1 : 50

Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)
.....

Drawing Title
Proposed Ground Floor

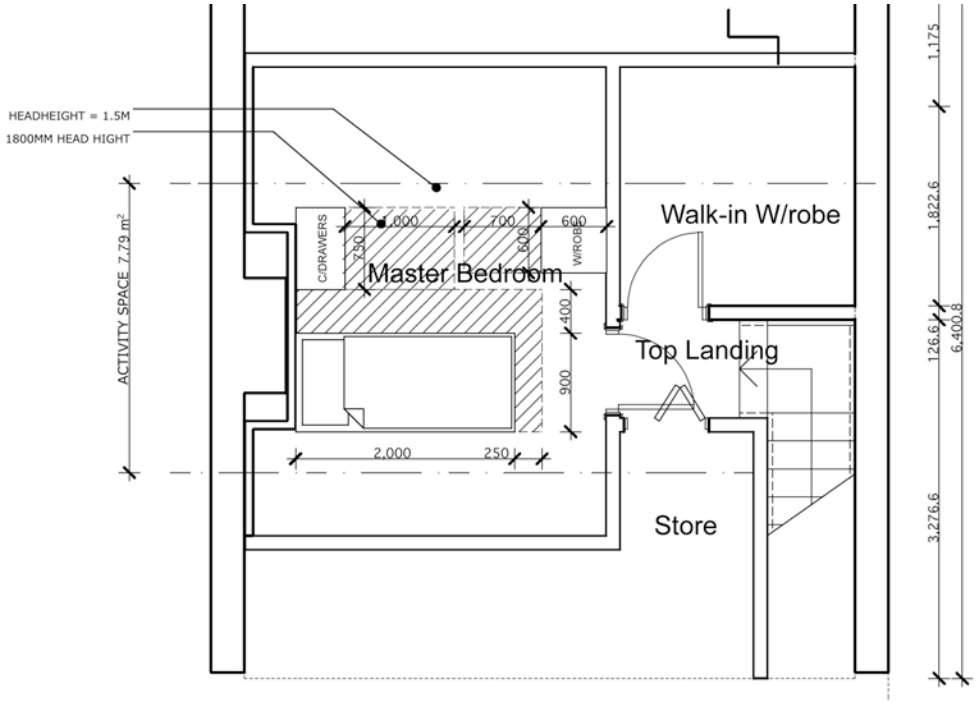
Drawing Status
Building Control Submission

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scales

Project Number	Drawing Number	Revision
001/05	**AL-BC/15**	

variablefrog@gmail.com •variablefrog



Attic Space Standards 1 : 50

Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)
.....

Drawing Title
Attic Space Standards

Drawing Status
Building Control Submission

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scales

Project Number	Drawing Number	Revision
001/05	**AL-BC/17**	

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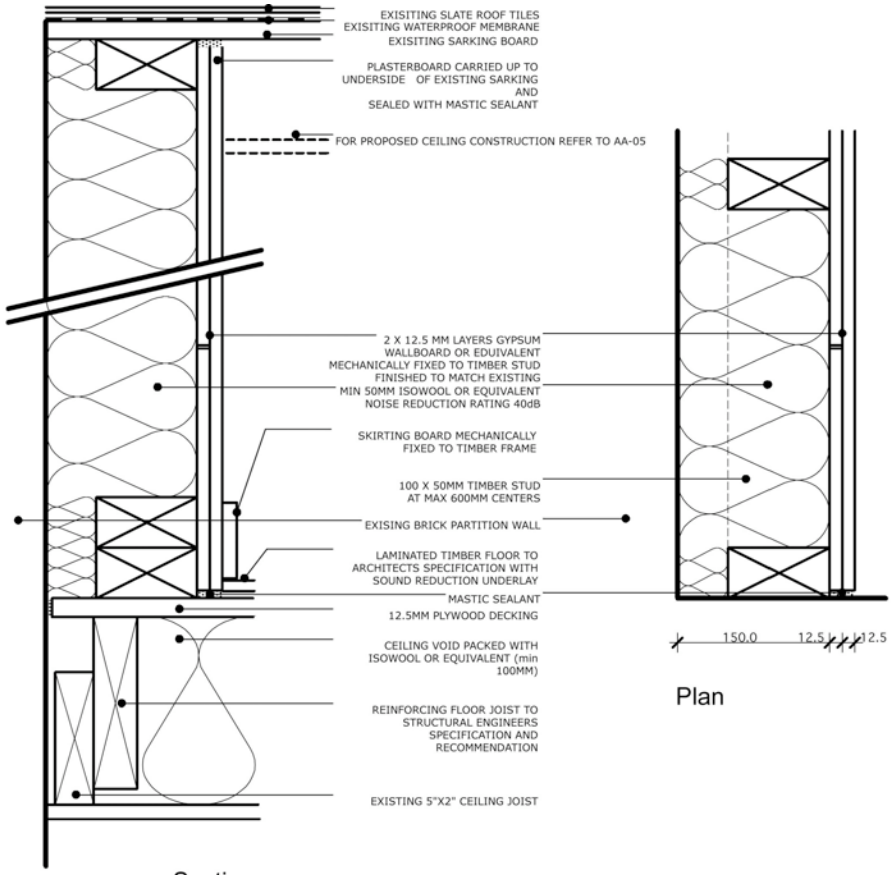


Section

Plan

Partition Wall (1 Hr Fire Separation) 1 : 5

Revision	By	Date

Job Title
Attic Conversion

Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

. . . . . .

Drawing Title
Partition Wall (1 Hr Fire Sepatation)

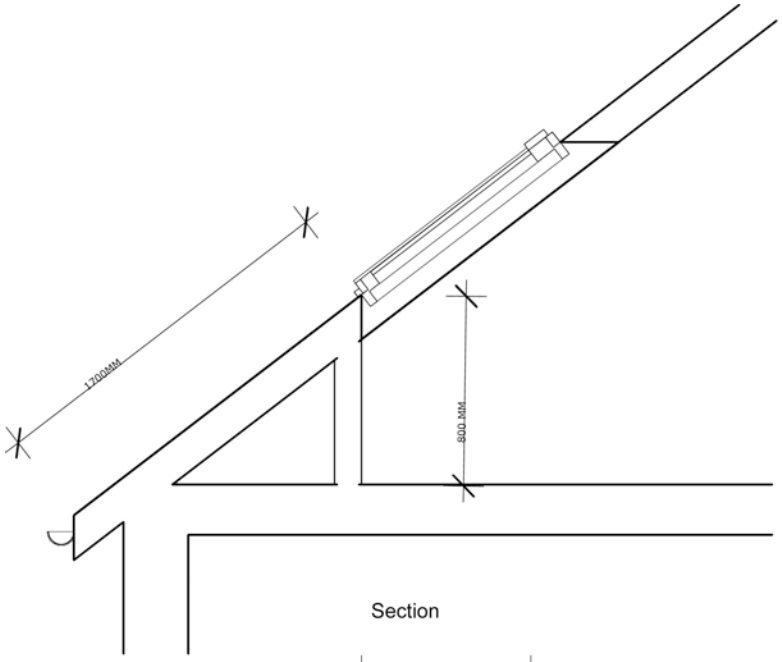
Drawing Status
CONSTRUCTION DETAILS

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

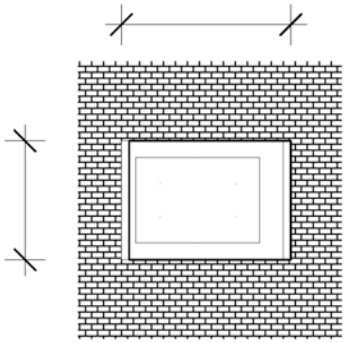
Scales

Project Number	Drawing Number	Revision
001/05	**AA-01**	

variablefrog@gmail.com •variablefrog



Section



Plan

VELUX WINDOW AA RATED MODEL GGL 3000 C02 (FOR ESCAPE) PROVIDES OPENABLE AREA 0.31 M^2 4000MM^2 TRICKLE VENTILATION. U VALUE 1.6 W/M^2 K
REVERSIBLE FOR CLEANING AND FITTED WITH AN OPENING RESTRICTOR TO PREVENT FULL OPENING.

BOTTOM OF OPENABLE AREA TO BE MAX 1700MM FROM EAVES AND MAX 1100 (MIN 600) FROM FLOOR LEVEL

GLASS TO COMPLY WITH BS 6262: PART 4 1994

Revision	By	Date

Job Title
Attic Conversion

Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
Escape Window

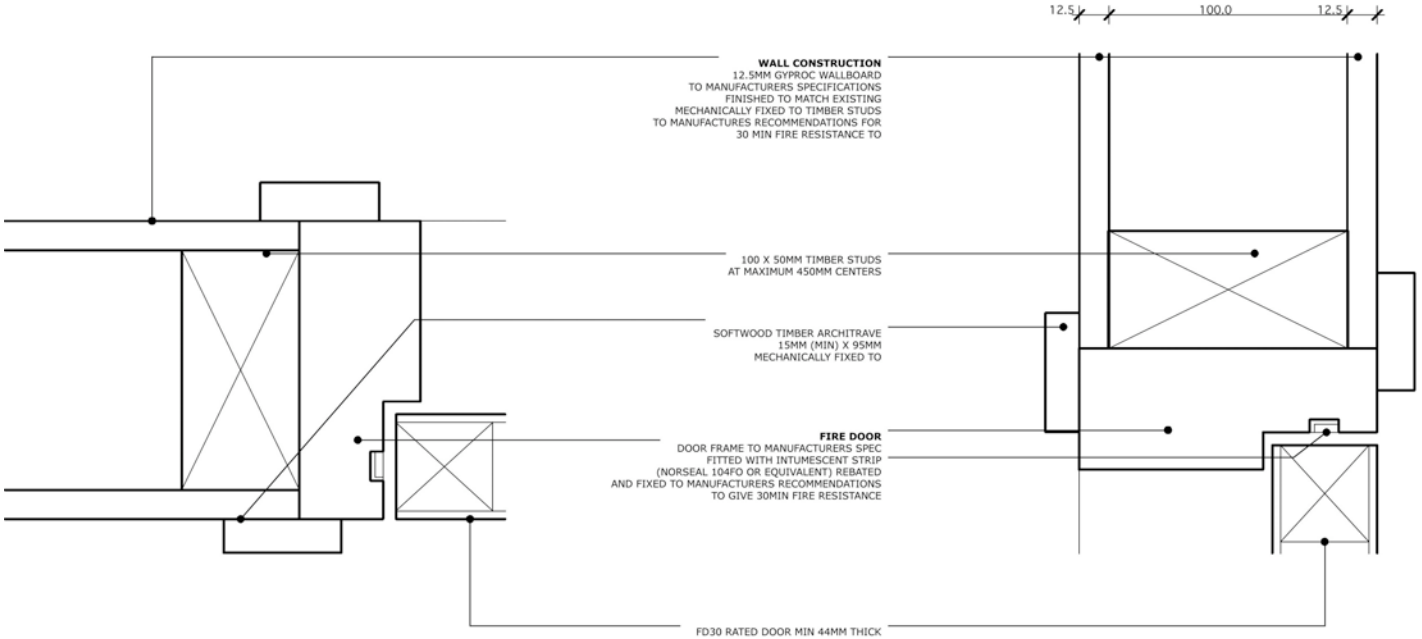
Drawing Status
CONSTRUCTION DETAILS

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scales 1 : 20

Project Number	Drawing Number	Revision
001/05	**AA-02**	

variablefrog@gmail.com •variablefrog



Door Jamb

Door Head

Revision	By	Date

Job Title
Attic Conversion

Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

.....

Drawing Title
Fire Door

Drawing Status
CONSTRUCTION DETAILS

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Sca 1 : 2

Project Number	Drawing Number	Revision
001/05	**AA-03**	

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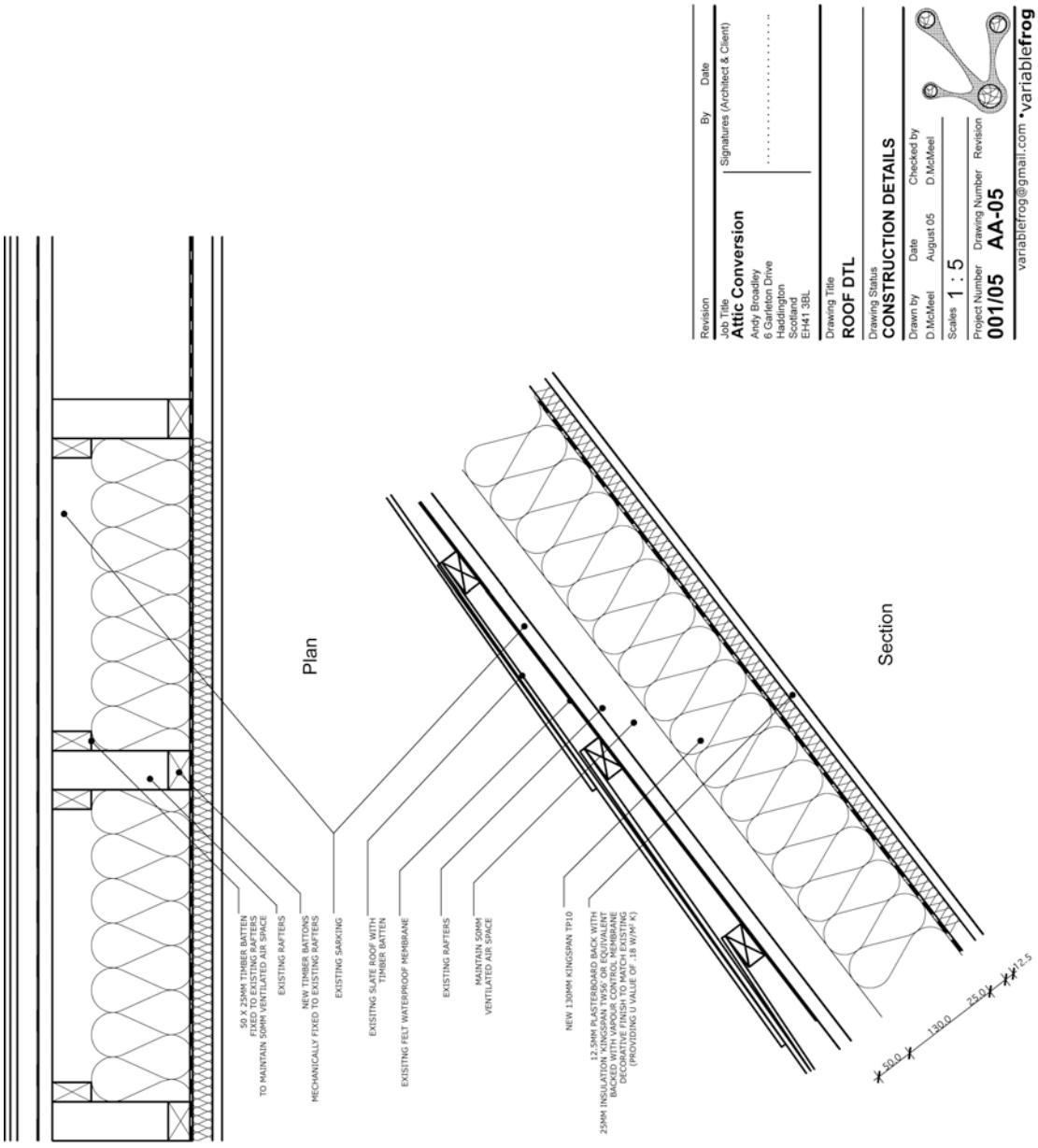
12.5MM GYPROC WALLBOARD TO MANUFACTURERS SPECIFICATIONS FINISHED TO MATCH EXISTING MECHANICALLY FIXED TIMBER STUDS TO MANUFACTURERS RECOMMENDATIONS FOR 30 MIN FIRE RESISTANCE
VAPOUR CONTROL MEMBRANE
130MM KINGSPAN TP10 (U VALUE 0.22 W/M²K)
100 X 50MM TIMBER STUDS AT MAXIMUM 400MM CENTRES MECHANICALLY FIXED TO PLYWOOD DECKING
LAMINATE TIMBER FLOORING TO ARCHITECTS SPEC LAYED TO MANUFACTURERS RECOMMENDATIONS FIXED TO 12.5MM PLYWOOD DECKING
TIMBER BATTEN
VAPOUR CONTROL MEMBRANE
EXISTING CEILING
270MM ROCKWOOL OR EQUIVALENT TO GIVE U-VALUE .16 W/M²K WITH VAPOUR BARRIER BELOW
EXISITNG SLATE ROOF WITH TIMBER BATTEN
EXISITNG FELT WATERPROOF MEMBRANE
EXISTING RAFTERS
MAINTAIN 50MM (MIN 25 AT EAVES) VENTILATED AIR SPACE
EXISTING SARKING
REFER TO ROOF DETAIL FOR ROOF CONSTRUCTION AND U VALUE
EXISTING BRICK WALL
Section
Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
EAVES DTL
Drawing Status
CONSTRUCTION DETAILS
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
1 : 5
Project Number
001/05
Drawing Number
AA-04
Revision
variablefrog@gmail.com
variablefrog


Plan
Section
50 X 25MM TIMBER BATTEN FIXED TO EXISTING RAFTERS TO MAINTAIN 50MM VENTILATED AIR SPACE
EXISTING RAFTERS
NEW TIMBER BATTONS MECHANICALLY FIXED TO EXISTING RAFTERS
EXISTING SARKING
EXISITING SLATE ROOF WITH TIMBER BATTEN
EXISITING FELT WATERPROOF MEMBRANE
EXISTING RAFTERS
MAINTAIN 50MM VENTILATED AIR SPACE
NEW 130MM KINGSPAN TP10
12.5MM PLASTERBOARD BACK WITH 25MM INSULATION "KINGSPAN TW56 OR EQUIVALENT BACKED WITH VAPOUR CONTROL MEMBRANE DOUBLE SKIN TO MATCH EXISTING (PROVIDING U VALUE OF .18 W/M² K)
50.0
130.0
25.0
12.5
Revision
By
Date
Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL
Signatures (Architect & Client)
Drawing Title
ROOF DTL
Drawing Status
CONSTRUCTION DETAILS
Drawn by
D.McMeel
Date
August 05
Checked by
D.McMeel
Scales
1 : 5
Project Number
001/05
Drawing Number
AA-05
Revision
variablefrog@gmail.com
variablefrog

Revision	By	Date

Job Title
Attic Conversion
Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
APEX DTL

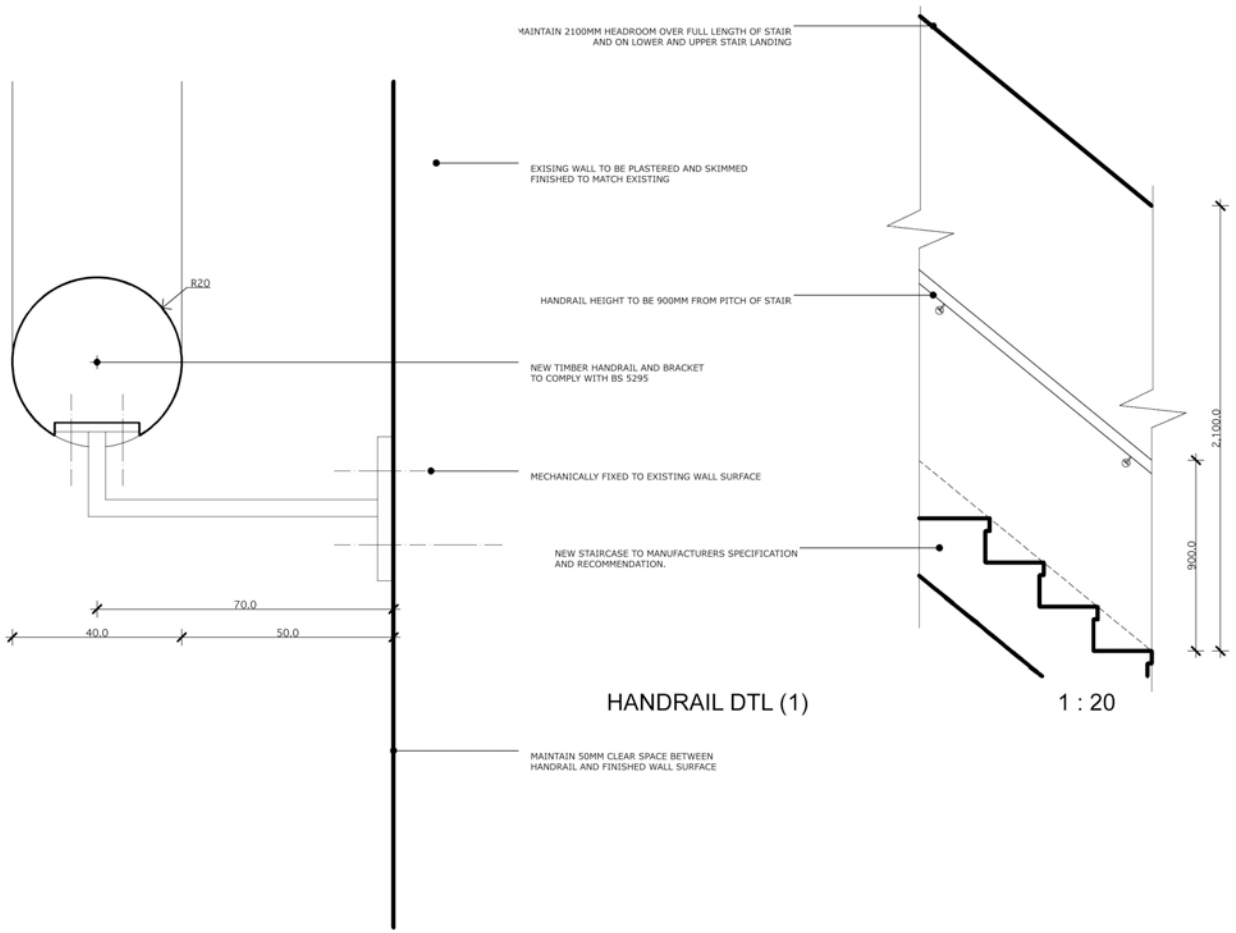
Drawing Status
CONSTRUCTION DETAILS

Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

Scale 1 : 5

Project Number	Drawing Number	Revision
001/05	**AA-06**	

variablefrog@gmail.com variablefrog



HANDRAIL DTL (1) 1 : 20

HANDRAIL DTL 1 : 1

Revision	By	Date

Job Title
Attic Conversion

Andy Broadley
6 Garleton Drive
Haddington
Scotland
EH41 3BL

Signatures (Architect & Client)

Drawing Title
HANDRAIL DTL

Drawing Status
CONSTRUCTION DETAILS

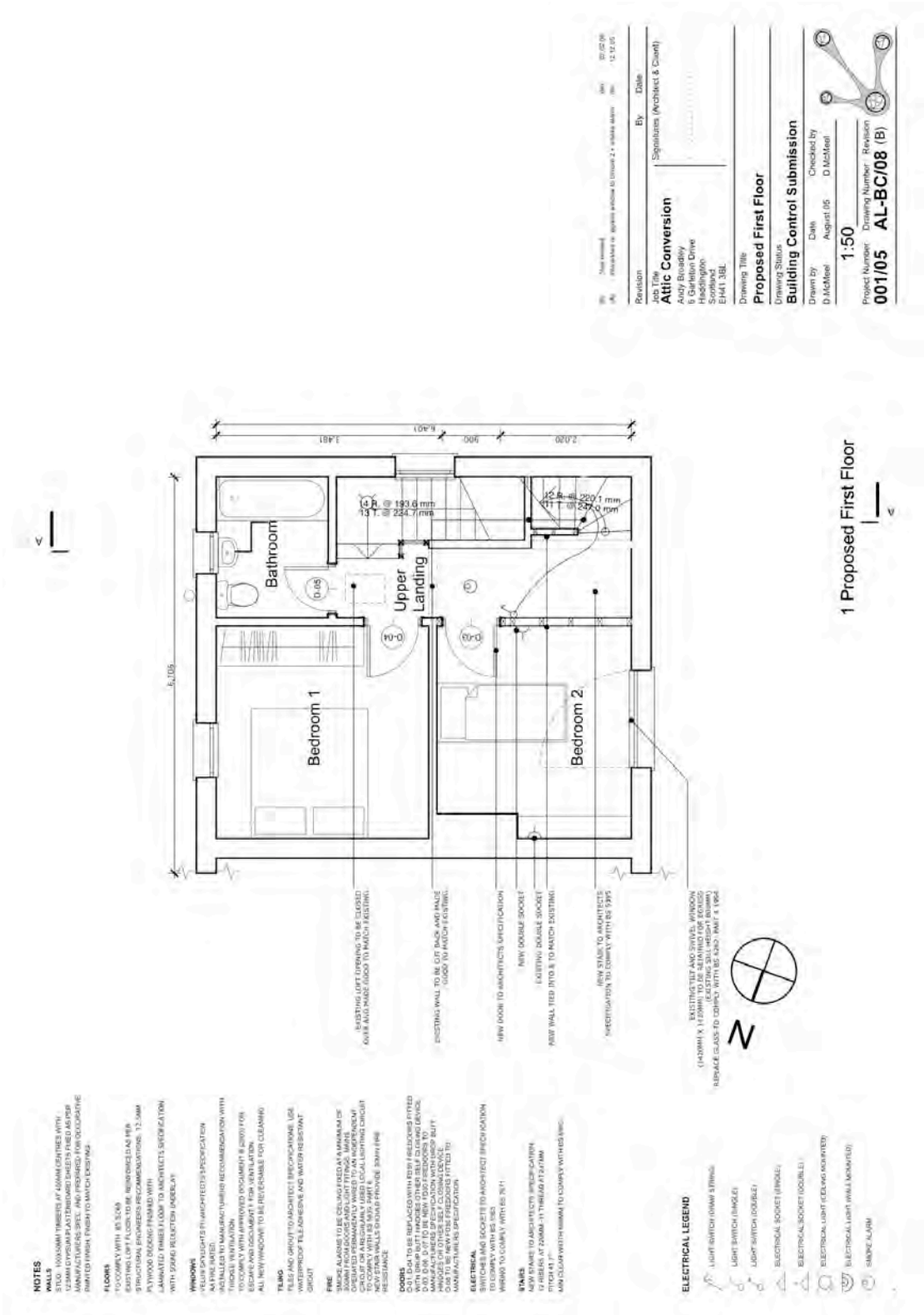
Drawn by	Date	Checked by
D.McMeel	August 05	D.McMeel

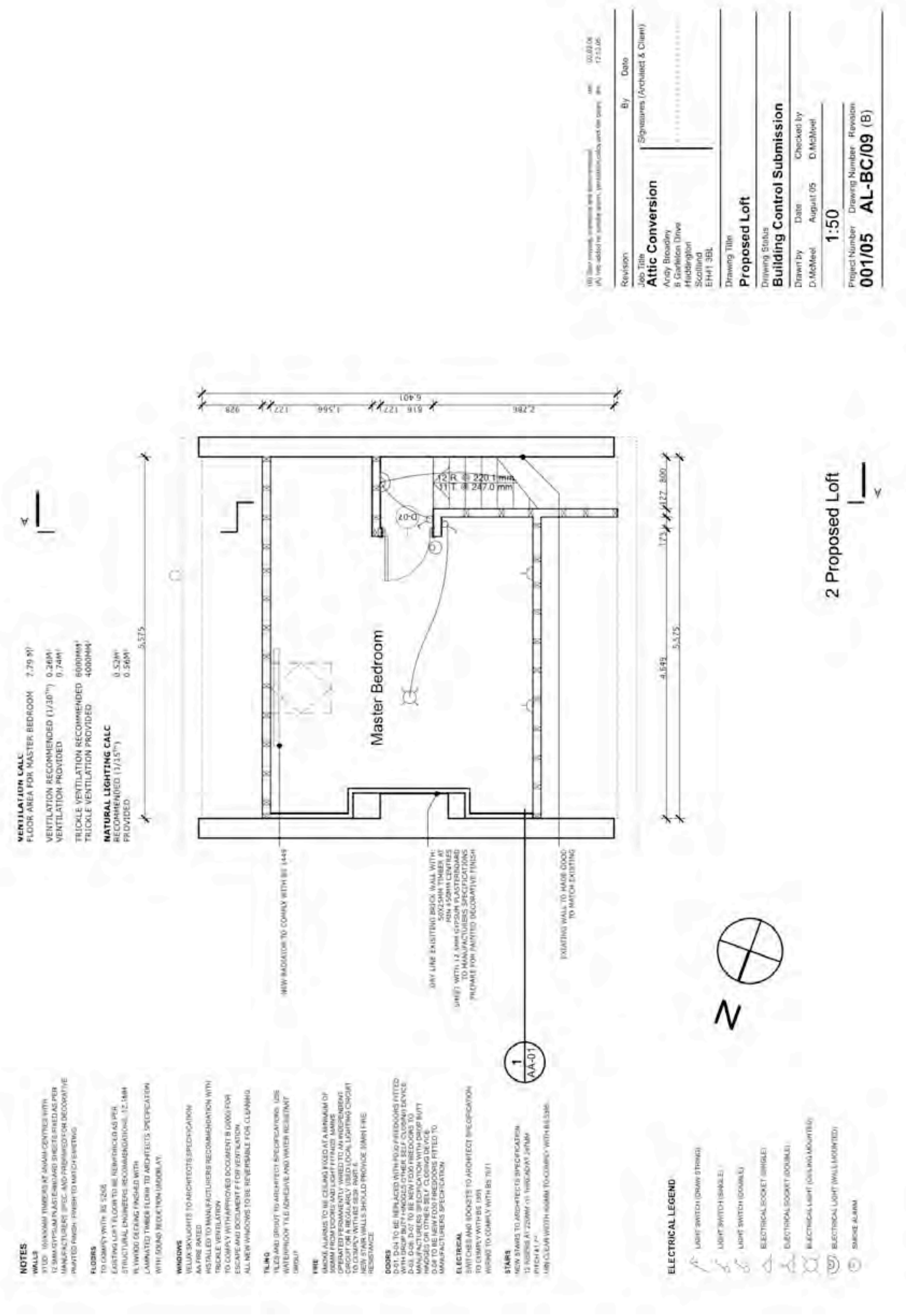
Scales

Project Number	Drawing Number	Revision
001/05	**AA-07**	

variablefrog@gmail.com •variablefrog

13.3. FINAL BUILDING WARRANT SUBMISSION




Master Bedroom
2 Proposed Loft
Attic Conversion
Proposed Loft
Building Control Submission
1:50
001/05
AL-BC/09 (B)

14. APPENDIX A-5: DOCUMENTATION

14.1. DRAWING ISSUE

Job Title: Roof space conversion-6 Garleton Drive 001/05

DRAWING ISSUE

		17 10 05	20 12 05	21 12 05	02 03 06								
AL-BC/01	Ex Grnd Flr	X											
AL-BC/02	Ex First Flr	X											
AL- BC/03	Ex Roofspace	X											
AL- BC/04	Ex Roof Plan	X											
AL- BC /05	Ex Font Elev	X											
AL- BC /06	Ex Rear Elev	X											
AL- BC /07	Ex Side Elev	X											
AL- BC /08	Pro First Flr	X	A	A	B								
AL- BC /09	Pro Loft	X	A	A	B								
AL- BC /10	Pro Roof Plan	X	A	A									
AL- BC /011	Pro Rear Elev	X	A	A									
AL- BC /012	Location Pln	X											
AL- BC /013	Ex Section A	X	A	A									
AL- BC /014	Pro Section A	X	A	A									
AL- BC /015	Pro Grnd Flr		X	X									
AL- BC /016	1st Flr SpStnd		X	X									
AL- BC /017	AtticSpStnd		X	X									

TO

Client												
Building Control	3	3		2								
Struct Engineer												
Main Contractor			1									
Electrician												

Job Title: Roof space conversion-6 Garleton Drive 001/05

DRAWING ISSUE

		20 12 05	21 12 05	31 01 06									
AA-01	Party Wall	X	X	X									
AA-02	Escape Win	X	X	X									
AA-03	Fire Door	X	X	X									
AA-04	Eaves	X	X	X									
AA-05	Roof	X	X	X									
AA-06	Apex	X	X	X									
AA-07	Handrail	X	X	X									
AA-08	Stair												

TO

Client												
Building Control	3											
Struct Engineer												
Main Contractor		1	1									

14.2. CORRESPONDENCE

14.2.1. 001_r_002

East Lothian Council

10th November 2005

Dermott McMeel
20 Chambers Street
Edinburgh
EH41 3BL

Dear Sir/Madam

Building (Scotland) Act 2003

BW No: **05/00897/BW**
Applicant: **Mr A Broadley**
Proposal: **Conversion of a roofspace into a bedroom/ensuite with associated access provisions**
Location: **6 Garleton Drive Haddington East Lothian EH41 3BL**

It is intended that I shall verify this application through to the granting of the building warrant.

I therefore provide the following report highlighting the points where either your proposals fail to meet the requirements of the current Building Standards (Scotland) Regulations or where additional information is required in order to assess the application: -

a) Technical Points

1. Fire

Technical Standard 2.2.1

1. Supply details of existing party wall to give required fire separation.

Technical Standard 2.8.1

1. Supply details of rooflight classification. AA

Technical Standard 2.9.30

1. Supply details of fire escape windows to attic bedroom and bedroom 2. ✓

Technical Standard 2.9.31

1. Supply details of the protected lobby fire doors 30min SCFDS/30min FD and walls 30 min fire resistant to front door (gf).

Peter Collins, Director of Environment
John Muir House, Haddington, EH41 3HA. Tel 01620 827827 or Fax 01620 827450

ENVIRONMENT

Technical Standard 2.11.1 and 2

1. Supply details of smoke alarms to attic, first floor and ground floor circulation spaces to comply with BS 5839: Part 6: 1995, Grade C, Type LD3.

2. Environment

Technical Standard 3.7.1

1. Supply waste pipe and trap detail layout for attic ensuite. Show fall and confirm no ceiling joists altered for drainage.

Technical Standard 3.10.7

1. Supply details of ventilation to roof: eaves, coombe and apex.
2. Supply details of vapour barrier.

Technical Standard 3.11.1 and 3

1. Supply details of space standards where minimum headroom 1.5lm.

Technical Standard 3.12.3

1. Confirm space standard to comply with min height requirement 1.5lm.

Technical Standard 3.14.3

1. Supply ventilation calculations for attic bedroom floor to open area of window.
2. Supply details of mechanical extract fan.

Technical Standard 3.14.5

1. Supply details of trickle vent 8000mm2 to attic window and 4000mm2 to en-suite.

Technical Standard 3.15.2

1. Supply details of roof insulation, ventilation and vapour barriers.

Technical Standard 3.16.1

1. Supply natural lighting calculation floor to window for attic bedroom.

Technical Standard 3.17.6

1. Confirm existing gas boiler has capacity for proposed work/extension.

3. Safety

Technical Standard 4.3.3

1. Confirm pitch of stair angle.

Technical Standard 4.3.3

1. Top flight: confirm number of rises/treads from mid landing.

Technical Standard 4.3.18

1. Supply details of handrail and height of pitch 840 - 1000mm.

Technical Standard 4.3.20

1. Confirm 2lm headroom over full length of stair(s).

Technical Standard 4.5.1

1. Supply electrical key to symbols.

Techncial Standard 4.5.2

1. Confirm extract fan low voltage to new en-suite.

Technical Standard 4.6.4

1. Confirm number of sockets to attic bedroom and bedroom 2.

Technical Standard 4.8.2

1. Confirm glass to velux rooflights comply with BS 6262: Part 4: 1994.

Technical Standard 4.8.3

1. Confirm cleaning of rooflights.

4. Noise

Technical Standard 5.1.1

1. Supply details of party wall and floor to comply with this Part.

Technical Standard 6.2.1

1. Supply details of insulation and U value for systems being specified.
2. Supply details of SEDBUK rating to heating.

b) Structural Points

1. Details are required for the complete structure.

2. The application for warrant indicates that no certificate from an approved certifier of design has been provided. Provide an approved certificate or provide evidence that the design has been designed by a suitably experienced person.

3. Details are required for the timber elements.

4. Details are required for the roof structure and bracing (truss or girder types, truss member sizes, timber grades and bracings to be specified and shown on drawings) as existing and amended.

Should you require clarification of any of the technical points noted in a) above please contact me on: -

- Direct telephone line **01620 827 235**,
- Fax **01620 827 723**, or
- Email **environment@eastlothian.gov.uk**,

and if you require guidance on any structural points noted in b) please contact **Andrew Sinclair,** Structural Engineer, on: -

- Direct telephone line **01620 827 251**
- Fax **01620 827 723**, or
- Email **environment@eastlothian.gov.uk**, and

Please quote this application reference number 05/00897/BW in all communications.

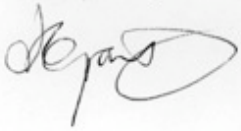
Please note that the above report is not exhaustive and the provision of further details or information may result in the need for further adjustments.

Once you have carried out the necessary adjustments I recommend that you contact me to arrange a mutually agreeable time to meet to ensure that the amended proposals comply with the Building Standards (Scotland) Regulations.

WARNING: If the above points are not resolve and the building warrant not granted within 9 months of the date of this letter, the application will automatically be deemed refused and a fresh application and the fee submitted will not be returned. If you then wish to progress with the proposals a fresh application and new fee will be necessary.

I have informed the applicant that I have issued this report and have advised that you be contacted to determine the timescale for clearing the above matters.

Yours faithfully,



14.2.2. 001_s_001

Dermott Mc Meel
20 Chambers St
Edinburgh
EH1 1JZ
e-mail: variabletrog@gmail.com
m/b 07788195597

20.12.05

Roof space conversion - 6 Garleton Drive

Les,

Further information and amendments as per your correspondence 10th November 2005 and our meeting of the 29th November 2005. Information provided for the relevant Technical Standards (TS) are as follows: -

Fire

- TS 2.2.1, see included drawing AA-01
- TS 2.8.1, see drawing AA-02
- TS 2.9.30, see additional info re: egress window on drawing AL-BC/08(A)
- TS 2.9.31, see drawing AA-03 Fire Door and Wall Construction and additional standard note under 'DOORS' for individual door treatment.
- TS 2.11.1 + 2, see AL-BC/14 (ground floor), AL-BC/08(A) (proposed first floor), AL-BC/09(A) and additional standard note under 'FIRE.'

Environment

- TS 3.7.1, omission of attic level en-suite.
- TS 3.10.7, see drawings AA-04, AA-05 and AA-06 for additional roof space ventilation information.
- TS 3.11.1 & 2, see AL-BC/15 & 16 for space standards.
- TS 3.12.3, omission of En-suite.
- TS 3.14.3, see AL-BC/09(A) with additional ventilation calculations, mechanical extract fan omitted with en-suite.
- TS 3.14.5 see AL-BC/09(A) trickle ventilation as discussed verbally.
- TS 3.15.2, see drawings AA-04, AA-05 and AA-06 for additional roof space construction details.
- TS 3.16.1, 5 see AL-BC/09(A) for natural lighting calculations.
- TS 3.17.6, see additional boiler information on drawing AL-BC/14.

Safety

- TS 4.3.3, see addition note under stairs on AL-BC/08(A) confirming pitch 40
- TS 4.3.3, see addition note under stairs on AL-BC/08(A) confirming 10 risers & 9 thread.
- TS 4.3.18, see drawing AA-07 for handrail detail and height.
- TS 4.3.20, see drawing AA-07 to confirm 2100mm head height over stair and upper and lower landings.
- TS 4.5.1, electrical key included.
- TS 4.5.2, extract fan omitted.
- TS 4.6.4, see additional info on AL-BC/08(A) and AL-BC/09(A) confirming 2 existing and 2 new sockets in bedroom 2, and 4 new sockets in attic bedroom.
- TS 4.8.2 see additional note re: glazing specification on drawing AA-02

- TS 4.8.3 see additional note re: reversible window on drawing AA-02

Noise

- TS 5.1.1, see drawing AA-01 with additional partition wall and floor details
- TS 6.2.1, see drawing AL-BC/14 with additional information re: boiler rating, and see AA-04, AA-05 & AA-06 FOR U-Value of systems used (U-values to comply with Technical Standard 6.2.1 column B).

Structural
Robertson Eadie (0131 466 2550) have been appointed as structural consultant and will be in contact to address the structural points.

Many Thanks

Signed

Dermott Mc Meel

14.3. SCHEDULE OF WORK

7/6 Joppa Station Place
Portobello
Edinburgh
Scotland
EH15 2QU
e-mail: yanablefrog@gmail.com

Job ref: S05.001.0

Schedule of Works

Stage	Date: Aug	Sept 5 12 19 26	Oct 3 10 17 24	Nov 1 7 14 21 28	Dec 5 12 19 26	Jan 2 9 16 23 30	Feb 6 13 20 27	March
						Ho Ho		
A Appraisal								
B Brief								
C Outline Proposal								
D Detailed Proposal								
E Final Proposal								
F Production Information				Building Warrant Approval				
G Tender Documentation								
H Tender Action								
J Mobilisation								
K Construction					1 2	3 4 5 6	7 8	
L Practical Completion								

14.4. BUILDING WARRANT APPLICATION

Dermott Mc Meel
20 Chambers St
Edinburgh
Scotland
EH1 1JZ
e-mail: variablefrog@gmail.com
m/b 07788195597

10th Oct 2005

Environment
East Lothian Council
John Muir House
Haddington
East Lothian
EH41 3HA

Application for Building Warrant for 6 Garleton Drive

Dear Sir/Madam

Find enclosed as per '*Building Control: Applications to Local Authority*' the appropriate documentation for an application for a Building Warrant in relation to the above property.

I hope the documentation is to your satisfaction, do not hesitate to contact me for further information or for clarification of details on the enclosed documents.

Regards

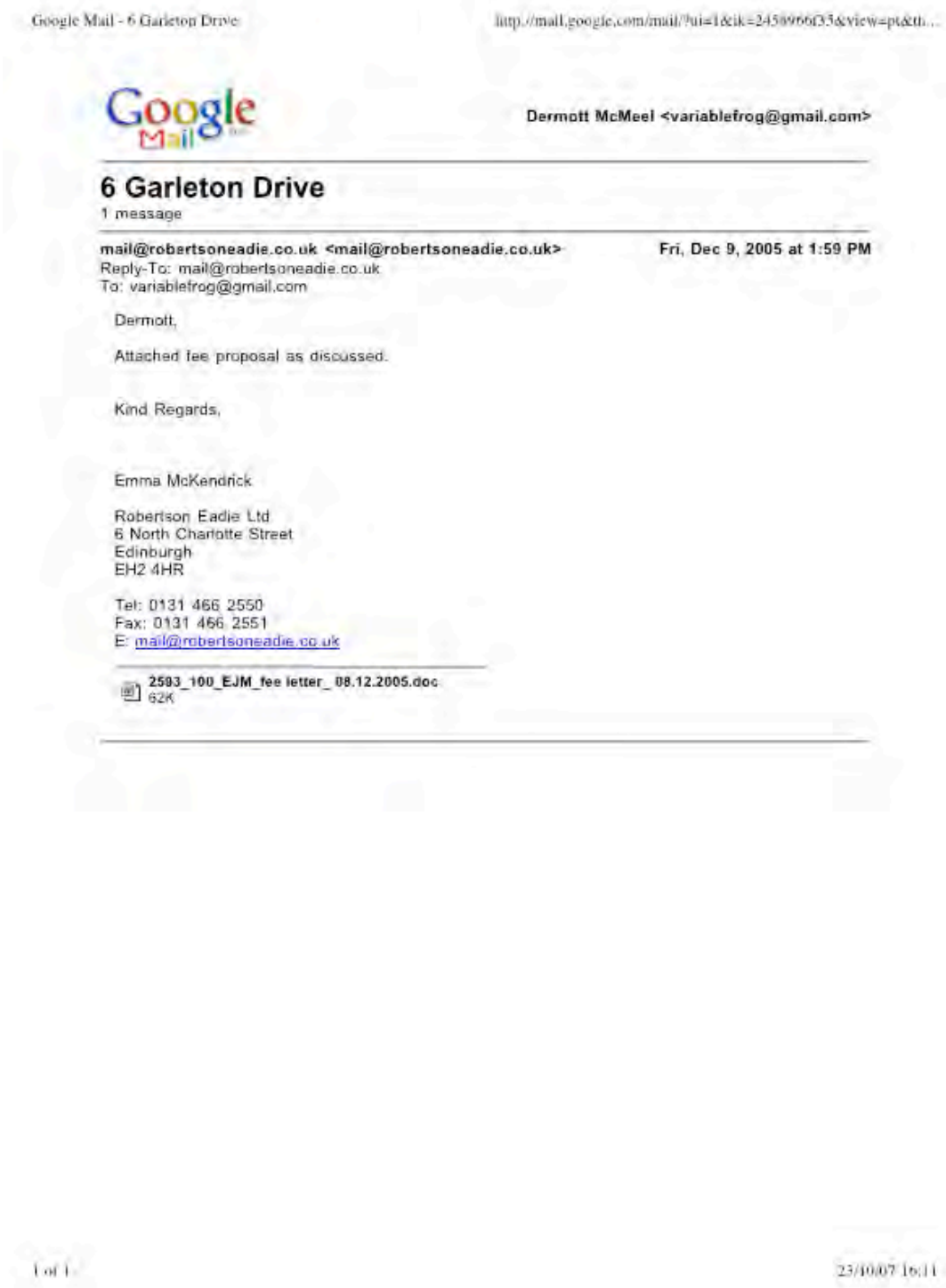
Dermott Mc Meel

Encl.

- Model Form A (Application for Warrant to construct / convert a building or to provide services / fittings or equipment)
- Fee (£100)
- 3 Paper copies of:

AL-BC/01 Existing Ground Floor Plan
AL-BC/02 Existing First Floor Plan
AL-BC/03 Existing Roof-space Plan
AL-BC/04 Existing Roof Plan
AL-BC/05 Existing Front Elevation
AL-BC/06 Existing Rear Elevation
AL-BC/07 Existing Side Elevation
AL-BC/08 Proposed First Floor
AL-BC/09 Proposed Loft
AL-BC/10 Proposed Roof Plan
AL-BC/11 Proposed Rear Elevation
AL-BC/12 Location Plan
AL-BC/13 Existing Section
AL-BC/14 Proposed Section

14.5. STRUCTURAL CORRESPONDANCE



Google Mail - 6 Garleton Drive http://mail.google.com/mail/?ui=1&ik=2458966033&view=pt&th...

Google Mail

Dermott McMeel <variablefrog@gmail.com>

6 Garleton Drive

1 message

mail@robertsoneadie.co.uk <mail@robertsoneadie.co.uk> **Fri, Dec 9, 2005 at 1:59 PM**
Reply-To: mail@robertsoneadie.co.uk
To: variablefrog@gmail.com

Dermott,

Attached fee proposal as discussed.

Kind Regards,

Emma McKendrick

Robertson Eadie Ltd
6 North Charlotte Street
Edinburgh
EH2 4HR

Tel: 0131 466 2550
Fax: 0131 466 2551
E: mail@robertsoneadie.co.uk

2503_100_EJM_fee letter_ 08.12.2005.doc
62K

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Google Mail

Dermott McMeel <variablefrog@gmail.com>

6 Garleton Drive, Haddington

1 message

Robertson Eadie <mail@robertsoneadie.co.uk> **Fri, Jan 6, 2006 at 3:06 PM**
Reply-To: Robertson Eadie <mail@robertsoneadie.co.uk>
To: variablefrog@gmail.com

Dermott,

Further to our telephone conversation please find attached an electronic copy of our drawing for 6 Garelton Drive. As dicussed you should receive a copy of the information issued to Building Control through the post.

Kind regards.

Emma McKendrick

Robertson Eadie Ltd
6 North Charlotte Street
Edinburgh, EH2 4HR

Tel: 0131 466 2550
Fax: 0131 466 2551
E: mail@robertsoneadie.co.uk

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292K

15. APPENDIX A-6: CONFERENCE PAPERS

15.1. DIRTY WORK: PRESENTED HCI 2004

Written in collaboration with Richard Coyne this paper explores the interconnection of dirt and authority. The themes of dirt and authority were emerging from my research at this point, as was the notion of Carnival as a model that could be appropriated as an alternative creative model for the construction process. Richard Coyne introduced the Hermetic Turn and proposed using the Installation Project as a narrative to tie these themes together for this conference.

Dirty Work

Abstract

This research explores the potency of dirt as a category for understanding digital communications. Our eventual target domain is communication in the construction industry, which is characterised by contractual formalities on the one hand (working documents, specifications, forms), and informal communications on the other (onsite instructions, scribbles on paper). Electronic communications (such as email and message boards) represent hybrid formal-informal media in the increasingly litigious workplace. On the way to understanding the untidiness of the construction site, we analysed the use of formal and informal communications in group working by students in the design and construction of an interactive digital art installation. Our research so far draws on the interesting relationship between dirt, authority, and human-computer interaction.

Keywords

Dirt, Computing, Communications, Authority, Creativity, Negotiation.

1. Dirt

Dirt is an important category within anthropological study [3], and is implicated in creativity and subversion, generating energy from its complex relationship with authority [6]. Within the digital realm dirt conjures up images of dust in the hardware, software viruses, and piracy [7]. Within the space between creativity and authority, dirt is found subverting, mocking, revealing and re-interpreting their limits.

Anthropological studies of dirt draw attention to how individuals or groups cross forbidden boundaries and return with some unknown contagion (dirt) [3], the word contagion in this example is purposefully used to invoke negative connotations; a punishment for transgression. In the modern era, rituals of regeneration, which celebrated the dirty and grotesque, were seen as vulgar [1] and frightening [3] in the process of redressing their offensiveness they became stripped of their regenerative power. “Purity ends in sterility” according to Hyde, while Bakhtin illustrates how festivals of creative expression (primitive ancestors to the modern carnival and mardi gras) were over time transformed into something to be feared, then sanitised by modern political agency. They were unlike primitive festivals that invoked disclosure and participation, which only later became sacred spectacles in which an

audience observed, and became separated from performers [1]. The festival existed between life and art, with mockery and laughter directed both outward and inward. In time the Medieval grotesque turned into something vulgar and to be feared (the Romantic grotesque). The dirty and grotesque with its propensity towards the creative became the vulgar and the dangerous.

The presence of dirt is an important creative catalyst, and attempts to totally expunge it are problematic and harmful. Dirt is commonly equated with noise and entropy in communications, and noise is an important characteristic of complex systems, ameliorating brittleness and the tendency to settle on states regarded as 'sub-optimal.' [8; 11; 9].

2. Authority

Disclosure and participation afford the possibilities of re-interpretation and re-evaluation. The strict rule of law draws away from disclosure and participation because such negotiation is thought to render the law unstable. The rule of law is then in danger of being sullied by 'the rule of persuasion.' [4; 2] The law must appear consistent, but to do so it must remain impartial. For Fish, strictly authoritarian, or rhetorical, law purports to be "a constraint on all fields of activity." [4] Fish favours a mode of authority predicated on "theory talk" (theory in practice) for its power to inform over rhetorical rules, and argues that we have judges and juries precisely because the law is messy [4]. It cannot be consistent, and needs to be opened to interpretation. In our study, the authority of various communications was revealed to be subject to a range of factors: the relationships between modes of communication, the authority of the big idea and its ad hoc attribution to an individual with the expertise to see it through. It also thrived on the give and take that developed. The grand theme turned out to have a totalising presence, but it accommodated variation and noise. It gave space for others to colonise and despoil.

3. The Installation Project

The project involved a six week task carried out by 33 postgraduate students at the University of Edinburgh. The aim was the creation of an 'installation,' the concept, content and execution of which were to be initiated by the students themselves. This involved discussing, elaborating and agreeing a theme, then designing and assembling the installation. The students were subdivided into smaller groups and designated specific sub tasks. The groups were encouraged to cross communicate and work together. In this preliminary study we reflect on how the electronic communications media at their disposal were utilised and what that may reveal about dirt and authority in group working.

The students had at their disposal an informally structured digital notice board (created using a MySQL database and ColdFusion). The last message posted on the board appeared at the bottom of the course homepage, which was set as the default homepage on all the Internet browsers on the course computers. It was a simple consecutive message board. A complete message list could be easily viewed if required, and no security measures were in place. Anyone could contribute. In week three of the program a more structured web-based 'forum' appeared, designed by students in the 'log team,' deploying the ColdFusion database environment that featured in the learning in a previous course. This forum was divided into sections

corresponding to each of the designated groups, and each section had a calendar and upload section. Each section was then further subdivided into topics, which anyone could add to. The students were initially encouraged to use the message board to post ideas for the installation. Subsequent to the project we conducted two small focus group studies to assess the way the groups used digital communications in the project. We recount key comments from students in what follows. We will present our preliminary observations under the themes of accretion and containment.

4. Dirty Accretions

Dirt builds up over time, as do cunning ideas for a group installation. The pivotal moment when students hit on an idea for the whole project was born of noise and chatter, rather than a formally directed procedure.

The project was devised by the teachers with a particular theme, more as a provocation than a directive, and students were encouraged to post suggestions for its development on the message board. According to retrospective accounts, the message board had little importance in this early discussion: “All the themes were discussed in class so there was nothing way out there.” On analysis of the record however, the message board did capture a moment which resonated with the rest of the class. Jim explained the creation of what became the motif for the project.

“That happened at two in the morning and we had this thing where we would post wacky ideas on the message board. There was one that completely flopped earlier that was about scaring people with a sub-woofer. People started to come and say they liked the (umbrella) idea and it eventually has become sort of an icon for the whole thing.”

The message board records a series of earlier, lesser triumphs. One contributor thought of projecting “a dynamic image of the city of Edinburgh,” that changes based on the “changing of audiences and their behavior.” One respondent thought of using a wall of “eMacs to great effect,” and making one large image: “I still like the erosion idea … we can just use the data as a constant stream for an installation, not necessarily to do some sort of erosion thing. The theme of change in Edinburgh is a good idea.” Someone else followed with “another idea, I thought maybe we could prepare some highlighters or pens or maybe watercolors for the visitors to leave their words, messages, names, whatever they like after they've seen our installation on the wall.”

But the dominant theme came a few postings later, from Frank: “We lend every visitor an umbrella, but we don't tell them what it's for. They then wander around the installation about weather and stuff holding an umbrella. And they will wonder why. Personally I think that is genius. Who's with me?” more than one enthusiast responded: “Yeah, that's genius. I'm with you, all the way, we just have to buy lots of umbrellas. This idea is a great transition between the transitions and erosion themes.” After various diversions, the message board returned to the new theme, with Frank’s posting: “I'm going ahead with the umbrella idea by the way…” Frank’s authority was bolstered by his involvement in the ‘interaction’ team, which ultimately controlled the technology. Other teams supported the theme, but were able to give scope to their own particular claims to genius through smaller screen displays dotted around the installation.

Unlike orchestrated group consensus forming activities like the KJ method [10], the message board discourse did not focus people on central ideas, or ideas that had a lot of group support, rather it recorded and revealed a fringe or edge event that slowly started to build up an accretion of positive approval, and later on other activities and aspect of the installation's construction constellated round this idea, until it became the central creative device for the project. The message board became this repository for chatter, noise or dirt which was building up around the installation. The process is easily characterised as the creation of a void which allowed dirt to gather, before finally the group latched onto one specific idea, and these creative and technical accretions then built up around that.

5. The Hermetic Turn

The message board was simply a sequential and unstructured medium requiring no registration, and usable by anyone in the world who knows the URL. There were no outside intrusions, but threads were interrupted. Some of the students took exception to the interruptions. It "was just sequential, people would get interrupted," whereas the forum was organised in terms of topics, so "you could check back."

"It was great because we were doing the big screen stuff and, the team that was doing the videos, we didn't even meet them once. We could ask them to do it in this format or compress it like that and they would do it and upload it."

However, the structured nature of the forum did disclose problems of categorisation. It became problematic to post a general message, because, as Steve expressed it:

"There was a bit of a problem with the privatisation within the groups. It was difficult to post something that everyone could see, if for example Jim was in my group and I wanted to post something for him, it would be extra effort for me to then post it to everyone."

While the compartmentalised nature of the forum redresses the earlier issue of interruption, it also emphasised the nature and value of general disclosure. The degree of privatisation in the forum was slight, but it made a difference to the extent participants could reach into each other's groups.

Returning to dirt, the issue can be couched in terms of the desirability or otherwise of containment and contamination. A break in the thread was taken as a kind of contamination, a distortion, which was addressed by containing the groups in their own topic areas. In turn, this led to difficulties in allowing ideas to spill over from one group to the next, or to broadcast insights to all groups.

The tendency towards bureaucratisation and compartmentalisation was interesting as it was not imposed or encouraged by the course teachers. One group developed the forum for the rest, perhaps thinking it was needed to ensure the survival of such a large group with such a complex project; a more authoritative repository for their digital discourse. Some thought the forum should be the exclusive medium of digital communication: "we should start posting on (the forum) from now on for general comments." When the result of that request was deemed unsatisfactory, messages like "Hi, I have posted a message here," followed by a link to the forum, were posted on the message board. Perhaps the creators of the forum had a "prejudice in favour

of the new" [5] and thought continued use of the message board was somehow subversive and undermining the authority of the forum.

6. Project as Festival

Needless to say the project ended in a kind of festival, but it was already a festival in the Bakhtian sense. As a creative exercise the project traversed the boundary between the clean and the unclean. The dirty medium of the uncontrolled message board did not give way to the structured forum. There was a complex interaction between the usages that developed around each, with other communications and group activities going on as well. Dirt does not exclude the possibility of a grand totalising vision. In fact the installation's success is attributable substantially to the flexibility that developed in the project to enable the fielding of alternative ideas, the space for other contributions to cluster around it, and the flexibility and control that the participants had over their media of communication. There is no prescription for successful group working here, just support for the provision of digital communications that encourage the accretion of dirt.

No doubt there are other helpful metaphors through which to explore these aspects of group communication, but dirt is useful in the context of a hands-on creative task such as the design and construction of an interactive installation on the theme of rain and erosion in a workshop. Our next challenge is to explore the place of dirt on the building site.

7. Acknowledgements

We are indebted to the contributions of Manolis Minopoulos, Borislav Dimitrov and Hao Ying Wang in our preliminary user studies.

8. References

[1] Bakhtin, M. (1984). Rabelais and his world. trans. Iswolsky, H., Indiana University Press.

[2] Bernstein, R. J. (1983). Beyond objectivism and relativism: science, hermeneutics, and praxis. Basil Blackwell.

[3] Douglas, M. (2002). Purity and danger: an analysis of concepts of pollution and taboo. Routledge.

[4] Fish, S. (1989). Doing what comes naturally: change, rhetoric, and the practice of. Duke University Press.

[5] Gadamer, H.-G. (1975). Truth and Method. (eds.). Barden, G. and Cumming, J., trans. Glen-Doepel, W., Sheed and Ward.

[6] Hyde, L. (1998). Trickster makes this world: mischief, myth, and art. Farrar, Straus and Giroux.

[7] Ludlow, P. (2001). Crypto anarchy, cyberstates, and pirate utopias. MIT Press.

[8] Rumelhart, D. E. and J. L. McClelland (1987). Parallel distributed processing: explorations in the microstructure of. MIT Press.

[9] Shannon, C. E. and W. Weaver (1963). The Mathematical Theory of Communication. The University of Illinois Press.

[10] User Interface Engineering. The KJ-Technique: A Group Process for Establishing Priorities,

http://www.uie.com/articles/kj_technique/

[11] Strogatz, S. H. (2001). Exploring complex networks, Nature. 410, 268-276.

15.2. TALKING DIRTY: PRESENTED AT CAADFUTURES 2005

This paper is written in collaboration with Richard Coyne and John Lee. This paper continues to explore the themes of official and unofficial within the context of collaborative activities, which we now begin to relate to the construction site. I had carried out the 'rumour machine' test cases, however Richard Coyne brought the themes of accretion and deletion to centre stage.

Talking Dirty: Formal and Informal Communication in Construction Projects

Abstract

We analyse the emergence and use of formal and informal communication tools in group working to aid in understanding the complexity of construction projects. Our test case is the design and build of an interactive digital installation in an exhibition space, involving students. After the project we conducted focus group studies to elicit insights into the effective use of the digital communications available for the project. We recount key insights from the study and examine how digital messaging devices are contributing to or hindering creative discussion.

Whereas the construction process is concerned with the removal of dirt and re-ordering, in this paper we reflect on construction's ritualistic, contractual and unauthorized aspects, and dirt's role within them. We draw on Bakhtin's theories of the carnival in exploring ritual, and the mixing of the un-sanctioned (rumour) with the official (contractual). How does dirt impinge on issues of communication, open discussion, and the move towards "partnering" in construction practice? We conjecture that while physical dirt might be unpleasant, the removal of other forms of metaphorical dirt hampers construction as an efficient and creative process.

1 THE POTENTIAL OF DIRT

We assume that the construction project is not merely a place in which instructions are carried out, but a locus of creative action. The processes of communication are highly creative. Dirt plays a part in this; its presence is an important creative catalyst in language. Hyde (1998) warns of the dangers of its expulsion, suggesting that "purity ends in sterility. Douglas (1978) illustrates the problematic of dirt as "matter out of place" (179), suggesting that something appears as dirt depending on one's perspective. This challenges Thompson's (1979) thesis that considers dirt and rubbish as a distinct category into which objects periodically move.

Dirt conjures up negative images of dust invading the hardware, and viruses assaulting software. From the period when clean rooms were required for computing, dirt strikes us as disabling. Within anthropological study, however, dirt is not wholly negative (Douglas 1978) and it is an important aspect of the carnival (Bakhtin 1984),

it is metaphorically potent and is implicated in creative and subversive actions. Dirt and redundancy (Reddy 1979) are often championed as important creative catalysts, and attempts to totally expunge them are harmful, and they are commonly equated with noise and entropy in communications (Shannon and Weaver 1963). Certain language theorists draw on noise and dirt as a necessary requirement of communication (Hyde 1998). Its inherent ambiguity is essential in language for understanding to occur (Wittgenstein 1953). This research explores the potency of dirt as a focal concept by which to understand digital communications (such as email and message boards), which are becoming commonplace in the increasingly litigious workplace.

Theorists readily draw on concepts of space and containment to define communications. At the very least, language is an exercise in categorisation, assuming similar meanings, under a particular word or sign. Reddy (1979, 187) suggests that these assumptions contribute to miscommunication, particularly when communicating across differing cultural categories. In formal communications there is an understanding that certain communiqués are meant for particular recipients, within certain categories of communications. This bureaucratisation of communications has its place, but communication also requires the transgression of boundaries (Deleuze 1988).

We provide a theoretical background to concepts of on-site communications, and how they are revealed in our study of a student design and build project. We outline a communication device developed in the web database environment of ColdFusion. We deliberately employed a prototype with limited (even disabled) functionality to elicit insights from an exploration of digital communication at the limit. Many of the cues we have come to assume in CMC (computer mediated communication) messaging are removed.

2 TOWARDS AN ANTHROPOLOGY OF THE CONSTRUCTION SITE

We consider the origins of construction site communicative practice in concepts of ritual, carnival, graffiti, rumour, catastrophe, interlocution, and the “return” of dirt.

2.1 Ritual

The construction industry harbours the remnants of ritual. The ceremony of “breaking ground” marks the first moment at which we disrupt the “natural” environment, and break through the pristine surface into the dirt below, arguably one of Vitruvius’ basic accounts of construction as residing in the placing of the primary gnomon. After a period of removing dirt, fighting and using it, the constructor marks the re-forming of the environment with the “topping-off” ceremony. What occurs between these two ceremonies is transitory, dirty and rarely celebrated. A notable exception is Japan’s Grand Shrine of Ise, where a constant rebuilding celebrates both the impermanence (Jones 2000, 246) and the procedural aspect of building. In some parts of the world, the construction site still retains its overt ritualistic aspects, against all the pressures of automation and industrialisation. Rather than a celebrity breaking ground with a silver spade, the occasion is marked by ceremonies of the carnivalesque, including animal sacrifice.

Rituals were “sharply distinct from the serious official, ecclesiastical, feudal and political cult forms and ceremonials” (Bakhtin 1984, 5). They had little place for

celebrity, other than in parodic gesture. These rituals served as a melting pot for labourers, architects, owners and engineers who would otherwise not meet. According to Bakhtin, the renewal and revitalisation that are the hallmarks of the carnival are brought about when hierarchical barriers are momentarily dropped, and populations cross-pollinate. The carnival, another celebration of the impermanent created an intriguing relationship between high (pure) and low (impure) society, and the interstices between.

This temporary suspension, both ideal and real, of hierarchical rank created during carnival time a special type of communication impossible in everyday life… permitting no distance between those who came in contact with each other and liberating from norms of etiquette and decency imposed at other times. (Bakhtin 1984, 10)

2.2 Graffiti

Graffiti has traditionally played an important role in construction and its rituals, from temporarily marking the ground as a means of laying out the geometry of the encampment or building, to the use of stonemasons' marks. Graffiti also plays a role in contemporary communications. On the one hand, contractual formalities (working documents, specifications, forms); the sanctioned communications on site, are virtually void as soon as they are released. On the other hand, a message scribbled on a wall (graffiti) might be a throwaway statement (dirt) or something else (paint colours, the location of a pipe or wire). What initially appears as graffiti becomes critical local site knowledge. The sign—of momentary importance—will eventually become redundant and overwritten plastered or painted, and disappear.

2.3 Rumour

The contract is one sanctioned channel of communication, particularly in legal relationships. When parties embark on a construction project, the contract prescribes what documents are to be provided (drawings, quantities, details), and how instructions are to be passed on. These formal means are rarely sufficient. Design and construction often overlap, and involve sketching, on-site chatter, rumour and negotiation. Digital photos are circulated, sketched over and discussed.

The unsanctioned channels of Internet and mobile communication technologies (PDA's, mobile phones, texting, voice mail, camera-phones, video-messaging) have infiltrated contractual communications. We conjecture that these communications promote creative discourse through the rumorem (Latin), that is, the noise and clamor of the construction site that cannot be ignored.

2.4 The Interlocutor

Pacheco was one of the site foremen who worked for architect and engineer Eladio Dieste. He was described as "a natural leader with an expansive personality, the ideal interlocutor between Dieste and the labour force" (Pedreschi 2000, 19). An interlocutor is one who facilitates dialogue and conversation. Dieste is often cited as a designer who engages in discussion and not just instruction. Discussion (Reddy 1979) and redundancy (Shannon and Weaver 1963) are necessary in any creative or open communicative environment. Interlocution provides a means of authorising

relationships, and renders contracts viable, given recent expression through the concept of “partnering” (Fisher and Green 2001).

2.5 Catastrophe

Construction is a dangerous business. The rituals of the pre-modern construction site included those that obviated risk, and accorded respect to the casualties of construction. As indicated in Vitruvius’ early account, the construction of civic projects is never far from the instruments of their destruction. Apart from the devastation wrought by war machines, and issues of health and safety on the construction site, communication is already imbued with a propensity towards overturning. (Katastrephein from the Greek is “to overturn.”) For some theorists, dirt is implicated in this “cusp catastrophe” through which value is created and destroyed (Thompson 1979).

3 TEST CASES in COMMUNICATIVE RITUAL

We tested the applicability of these themes in a context in which an appropriation of dirt carries less risk than the construction site, namely a student design and build project (which we will extend to the communicative practices of the hard hats and suits of an actual construction site in phase two of the project), later we deployed a disabled messaging device, which was informed by our initial results from the installation, to explore these themes further.

3.1 The Workshop

We allude here to a six week project carried out by 33 postgraduate students at the University of Edinburgh. The aim was the creation of an “installation,” this involved discussing, elaborating and agreeing a theme, then designing and assembling the installation in a workshop, commandeered as an exhibition space. The students were divided into groups and designated specific tasks. They were encouraged to work together and cross-communicate. In this preliminary study we reflect on how the electronic communications media at their disposal were utilised and what that reveals about dirt and communication in group working.

The students had at their disposal an informally structured digital notice board (created using a MySQL database and ColdFusion). The last message posted on the message board appeared at the bottom of the course homepage (Figure 1), which was set as the default homepage on all the Internet browsers on the course computers. A complete message list could be viewed easily if required, and no security measures were in place. Anyone could contribute. In contrast, by week three of the program a more structured web-based “forum” (Figure 1) appeared, designed by students in the “log team,” deploying the ColdFusion database environment that had featured in the learning in a previous term. This forum was divided into sections corresponding to each of the designated groups. Each section had a calendar and upload section. Each section was then further subdivided into topics, which anyone could add to. The students were initially encouraged to use the message board to post ideas for the installation. Subsequent to the installation project we conducted two focus group studies to assess the way the groups used the two forms of digital communications in the project.

Figure 1 Digital Graffiti and Formal Forum

3.2 The Rumour Machine

To further explore the phenomenon of rumour, its spread and demise, accretions and deletions, spread and consolidation, as observed in the installation project, we also designed a follow-up, very limited, messaging device which was deployed later during general studio work. The messaging device was radically stripped down, devoid of threads and compartmentalisation. It included a class list (for each contributor to tick) and a single text field containing an editable instance of the current text. Additions were incorporated into the existing text at the discretion of the user. Initially the procedure was anonymous, and after a few days, a thread was revealed which would show different instances of the text to the user as it evolved. We seeded the messaging device with an initial proposition (about Bakhtin's theme of embodiment), prompting the users to elaborate on a theme with which they were becoming increasingly familiar. The messaging device was world readable and the students were encouraged, over the course of one week, to contribute.

Following a focus group with the students to discuss the results, we decided to seed the messaging device for a second time, with a paragraph of text that would promote refinement, rather than elaboration, of a topic. This involved a slight modification of the device to limit the amount of text it would hold. Otherwise the device remained the same. This time (based on the focus-group discussion) the device was seeded with the intension to create a succinct description of the city of Edinburgh. What follows are observations from the usage of a forum device, a message board and a disabled messaging device (a rumour machine).

3.3 A Community of Interlocutors

The pivotal moment for the installation project, when participants hit on an idea for the whole project, was born of noise and chatter, rather than a formally directed procedure. The project was devised by teachers with a particular theme, more as a provocation than a directive, and students were encouraged to post suggestions for its development on the message board. According to retrospective accounts, the message board had little importance in this early discussion: "All the themes were

discussed in class so there was nothing way out there," said one participant. On analysis of the record however, the message board did capture a moment which resonated with the rest of the class. Jim explained the creation of what became the motif for the project:

That happened at two in the morning and we had this thing where we would post wacky ideas on the message board. There was one that completely flopped earlier that was about scaring people with a sub-woofer. People started to come and say they liked the (umbrella) idea and it eventually has become sort of an icon for the whole thing.

But the dominant theme came a few postings later, from Frank:

We lend every visitor an umbrella, but we don't tell them what it's for. They then wander around the installation about weather and stuff holding an umbrella. And they will wonder why. Personally I think that is genius. Who's with me?

More than one enthusiast responded: "Yeah, that's genius." After various diversions, the message board returned to the theme, with Frank's posting "I'm going ahead with the umbrella idea by the way..."

Unlike orchestrated group consensus forming activities such as the KJ method, the freedom afforded by the installation project message board discourse did not focus people on central ideas, or ideas that had a lot of group support. Rather, it recorded and revealed a fringe or edge event that slowly started to build up an accretion of positive approval, and later on other activities and aspects of the installation's construction constellated round this idea, until it became the central creative device for the project. The message board—which was just a sequential record of contributions—became this repository for chatter, noise or dirt that was building up around the installation. The process is easily characterised as the creation of a void, which allowed dirt to gather before the group finally latched onto one specific idea, and these creative and technical accretions then built up around that. While never deleting the redundant ideas the message board pushed them further away. Much as an unchecked rumour gathers momentum and provisional authority by regurgitation and reiteration, so do ideas.

3.4 Digital Graffiti

It reminded me of graffiti on a toilet door, you write it and its there, you can overwrite someone else's. (Martin)

Turning our attention to the rumour machine, we found that there was an obvious freedom with the anonymity it initially afforded. Martin suggested that he "felt that was sort of liberating though, that you could say what you wanted to say and you didn't have to sign it." It also seemed that the anonymity relieved him of certain burdens, such as "looking at who said what, although you could see threads starting to emerge from the text." There seems to be a freedom in not knowing to whom you are responding.

Some complained that there "should maybe have been something in place where you couldn't delete someone else's [contribution]" although no one did. David assured us he would have, only he "thought it would mess up what you [the interviewers] were doing."

Graffiti ages, it gets covered over, renewed or removed. The passage of time inflects the visual record. The absence of differentiation, which initially Martin considered liberating, became a problem. Pope, who was one of the last to contribute, noted, "Tangents were starting to emerge. There was no flow of an argument or discussion so I just responded to the first three [points]." This is when dirt return becomes problematic.

Merely allowing accretions to gather—as in the case where we seeded the device and prompted for elaboration—can "overload" the communication channel (Shannon and Weaver 1963, 26), and obscure the entire conversation. It was suggested that "maybe a change of colour for each different contribution" (Vern) would solve the problem, indicating that some form of differentiation was desired for the task of elaboration. The entire channel became contaminated by indiscriminate participation. The system lacked authority by removing the articulation of its multiple authorship. No one knew what was current, where one contribution began or ended, or who was the author of what. What was required perhaps was some form of collapse, which would take with it the less robust contributions.

4 Catastrophe

The message board for the installation was simply a sequential and unstructured medium requiring no registration, and usable by anyone who knows the URL. There were no outside intrusions, but threads were interrupted. Some of the students took exception to the interruptions. It "was just sequential, people would get interrupted," whereas the forum was organised in terms of topics, so "you could check back."

4.1 Contamination

However, the structured nature of the forum did disclose problems of categorisation. It became a problem to post a general message, because, as Steve expressed it:

There was a bit of a problem with the privatisation within the groups. It was difficult to post something that everyone could see. If for example Jim was in my group and I wanted to post something for him, it would be extra effort for me to then post it to everyone.

While the compartmentalised nature of the forum redresses the earlier issue of interruption, it also emphasised the nature and value of general disclosure. The degree of privatisation in the forum was slight, but it made a difference to the extent participants could reach into each other's groups. The issue can be couched in terms of the desirability or otherwise of containment and contamination. A break in the thread was taken as a kind of contamination, a distortion, which was addressed by containing the groups in their own topic areas. In turn, this led to difficulties in allowing ideas to spill over from one group to the next, or to broadcast insights to all groups.

4.2 Collapse

In his inquiry into "the creation and destruction of value" Thompson (1979) suggests that an inevitable effect of a unidirectional transaction—in his particular case constant value increase—is eventual collapse. He calls these events "cusp catastrophes." Brown (2004) suggests that where there is a uni-directional flow—ie

consistent taking without giving, what Thompson describes as a catastrophe— is merely a necessary means of returning a system to a form of equilibrium.

Illustrating the nature of communicative catastrophe, after several unrelated contributions the following appeared on our "rumour machine," seeded to refine and focus a discussion about the attributes of the city of Edinburgh. It seemed to resonate with others:

You can walk on air, climb really high and as the mist begins to clear, float in the moonlit sky inspired by the rising audio-visual cornucopia. Laptop in hand, try landing softly on Arthur's Seat ready to download the genius that is your creative vision.

Over the course of four iterations by different users this paragraph evolved into a proposition more in keeping with the culture of cyber-punk or garage culture.

You can walk on air in the Wyndy [sic.] city and emmerse yourself in the architecture, cuisine, and culture. Wireless networks were conceived to connect such a space to the wider world. Within the University's digital village lie 64bit floating point and highland computer games - everything is here to help you define your reality.

Then a "cusp catastrophe" returned the thread to the sentimental:

Have you ever thought of living in a place that carriages the beauty of the medieval age, covered by a veil of mystery, offering so many things to do?...Though so inspiring that it impels you to create!

The instances that immediately followed had a similar flavour to this, not at all like the previous four. Nor did anyone pick up the theme of the previous variants once the "thread" was broken. The "rumour machine," seeded with a proposition for elaboration, became disconnected. When seeded to refine or contain a particular narrative it had a tendency to converge, though countered with sporadic interruptions, and returns to the prosaic or clichéd. This cycle seems consistent with propositions by Brown and Thompson, a behaviour consistent with the nature of rumour. On the one hand, in so far as the construction site participates in the workings of rumour, it is open to distortion and misunderstanding. On the other hand, this is the backdrop against which construction practice operates. At times onsite instructions constitute part of the background noise, at other times they operate as catastrophic interventions, breaks in the thread, or returns to normalcy.

5 Conclusion

The creation of the installation is somewhat distant from a construction site. But dirt is a useful concept in the context of practical group tasks. Engaging with dirt does not always deliver expected outcomes.

Our installation project ended in a kind of carnival, but it was already one in the Bakhtian sense. As a creative exercise the project traversed the boundary between the clean and the unclean. The dirty medium of the current—but impermanent—message board did not give way to the structured forum. There was a complex interaction between the usages that developed around each, with other communications and group activities going on as well. Dirt does not exclude the

possibility of a grand totalising vision. In fact the installation's success is attributable substantially to the flexibility that developed in the project to enable the fielding of alternative ideas, the space for other contributions to cluster around it, and the flexibility and control that the participants had over their media of communication.

Our "rumour machine" garnered varied results depending on how it was seeded. Elaboration of a narrative or idea seemed inhibited by the permanence of the accretions. There was confusion, yet users reported being "liberated" through anonymity: Perhaps this was a temporary Rabelaisian suspension of hierarchical rank When seeded for refining a narrative, we observed not so much "cusp catastrophes" as events which collapsed the narrative, allowing it to be rebuilt. Clearing away what had accumulated and deliberately retained, a celebration of the temporary and impermanent.

There is no prescription for successful group communication here, just support for the provision of digital communications that promote collaborative engagement, and an exhortation to return to consider the seeds of construction site practice in carnival, graffiti, rumour, catastrophe, interlocution, and dirt, at least in terms of the rituals of communication.

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15.3. PRE-ONTOLOGY: PRESENTED AT TOWNTOLOGY 2006

This paper was written in collaboration with John Lee. The themes of mess/unofficial and standardisation/official were now key themes in the development of this Thesis. John Lee introduced the subject of ontology and a theoretical communicative framework that I could apply to the cultural differences between the different participants involved in construction.

"Pre-Ontology" Considerations for Communication in Construction

Abstract

We address the question of how the use of ontologies can assist communication in construction. We consider the background to this question in contemporary and emerging practices, and contend that due to the particularity of building site contexts current approaches involving broad standardization are not promising. We argue that ontologies should be thought of as higher-level conceptual tools for revealing areas of disagreement or differences in understanding. We propose that their use could usefully be integrated with a system for capturing negotiation aimed at resolving these differences.

1 Introduction

In this paper, we address the question of how the use of ontologies can assist communication in construction. We consider the background to this question in contemporary and emerging practices, both on building sites and among those working to develop assistive technologies. We observe that, to the extent these practices currently meet, the meeting is not as fruitful as it might be, and we seek to identify possible ways to improve it. Refined uses of ontologies are often thought to be a key factor in achieving such improvement; we examine this idea and conclude that some promising uses of ontologies might be rather different to those usually envisaged.

2 The Building Site

Our focus in this paper is on the building site, especially where a large project is in progress. This focus is natural given our interest in communication. On a large building site, there are many activities that bring out and emphasise issues of

communication. The overall pattern is very fluid; little stays the same throughout the construction project, and few people may be involved in the whole process from beginning to end. For example, there is commonly a succession of specialised contractors who arrive on the site to carry out some particular task (which may take hours, days or weeks), and then leave. While present, they need to interact with those already there, and with others who may arrive. They may bring their own specialised workers and equipment, but also may use equipment otherwise in place (tower cranes, perhaps). They will have to interact with the site and construction state as they find it, and will probably change it (by carrying out earthworks or installing services) or add to it (by erecting some component, installing a cladding system, etc.). Often, they will bring and install building elements that have been manufactured off-site, and this may well involve finding that there are discrepancies in detail between their expectations and what is actually present on the site; there may need to be adjustments and alterations.

Whatever happens, there will almost inevitably need to be discussion and negotiation. And this discussion or negotiation has a number of interesting characteristics, such as the following.

1. It takes place very often between strangers. Contractors tend to move from site to site, carrying out broadly similar operations for different projects. Few of the contractors involved in a project may have worked together before. The nature of the project, and its similarity with other projects, will of course provide a shared context for any discussion, but still those involved need initially to some extent to feel their way towards an understanding of the other's apprehension of any given problem.

2. It is local and specific to the situation on a given site. No matter how similar two projects may be, what happens on a site is always affected by the detail of the site itself, the particular nature of the things that have been assembled on it, and the individuality of those who have been involved.

3. It occurs in the context of a dense web of regulations, documents, standards, procedures, and against a background of increasingly litigious demands for performance to contract. The construction industry is very richly provided with documentation at all stages of a project, and the framework of laws and regulations surrounding site practices, design requirements, materials specifications, and almost every other aspect of the activity, is enormous. Very little is supposed to happen that is not clearly specified in advance, or noted carefully as some sort of clearly justified and agreed variation.

3 Standardisation

In the problematic situation just described, a natural and common reaction is to suppose that the best approach to keeping matters under control is to standardise everything. Many things are standardised already, of course, especially building components and operations. If standard components are being assembled in standardised ways, then it is natural further to suppose that we can standardise any discussion that needs to take place around these. We can have standardised vocabularies, and standardised communication tools. To make sure that there is no uncertainty, we can formalise human roles and relationships. If there is no scope for non-standard actions, then nothing can happen that has not been anticipated, and for

which there is not already a defined procedure or protocol. This should mean that quality can be much more effectively controlled, as well as safety, cost, etc.

As Konrad Wachsmann [12] put it, “the industrialised process can only have its full effect within a system of all pervasive order and standardisation”. But Wachsmann was a pioneer of industrialisation in construction, whose particular systems have not survived. It’s certainly at least arguable that his systems failed to survive because they were not sufficiently adaptable. Looking at his USAF Hangar Project, what appears as a modular repeatable system requires nuanced detailing for the repetition to succeed. The problem with imposing a system of all pervasive order is that it assumes things are neat and can easily be kept tidy, and that they exist in a stable environment. But in reality, this is often not the case.

4 Mess

Building sites are messy. One need not spend long looking at them to realise this. Particular topographies and geologies have to be coped with, the weather cannot be controlled, there are delays and other complications that arise from unknown conditions off the site. Although increasingly industrialised, the process is far removed from the operations of sleek robots on an assembly line, partly because the majority of processes that can be industrialised to that extent have already been removed to factory assembly lines and those that remain on site have to cope with the unrelieved particularity of their situation. On the building site, things are not easily kept neat and tidy, so processes need to exist that can be used to move them back towards that state when they drift away (approved drawings), or to legitimise the drift (variations and Architect’s Instructions). There are procedures (and much associated documentation) to handle issues like delays, unexpected or inappropriate deliveries, accidents, etc. But all of these require interaction between people, and this alerts us to a somewhat hidden but actually very important aspect of the mess around a building site: communication is also messy.

The messiness of communication in construction has been discussed elsewhere [8]. There, it is argued that sanctioned and formal modes of communication are inadequate, in practice, for the day-to-day needs of building site reality. The procedures and protocols, documentation and regulation, in fact create a system of a complexity and inertia that would render much of the needed communication impossible. The smooth operation of construction projects is dependent on gaps and slippage between formal communications. This theme is enlarged in McMeel [9], on which we draw to some extent in what follows. It is emphasised that the kinds of issues we have been discussing often demand a creative solution. People need the freedom to elaborate their approach in an unanticipated way. Information may need to be created, communicated and manipulated quickly and flexibly. The route to a solution is not provided, or perhaps even accommodated, by the formal mechanisms available, at least without unacceptable difficulty and delay. When these formal communicative systems do accommodate such information it is in danger of being misunderstood and mis-represented as it moves between different interest groups; when they cannot accommodate such information it becomes fragile and in danger of being lost. Within an environment such as the construction site, which is constantly in a fluid state, the perception and validity of specific information that is delivered in

quantitative or schematic form from an office environment can accidentally be changed or lost when it enters the site, causing costly delays or confusion.

The relevance of a particular piece of information depends not only on who has it and where they have it, but most importantly it can depend on when they have it. Observation of site activities readily yields examples. Information sketched on a plasterboard wall, regarding the position of insulation and the air gap required, can be right beside the location where the detail is applicable, and it is relevant to the location until all the insulation and plasterboard is erected, at which point it will become redundant and will be subsequently plastered over. Similarly, it transpires that often on a building site when vital information is required, staff do not follow the sanctioned channels but rather seek a path of lesser resistance and reach for their mobile phone. The mobile, which site regulations deplore or even outlaw, offers an irresistible immediacy but also an irreplaceable and untraceable informality. Information can be accessed exactly when needed, and it can also be discussed, negotiated and translated without the constraints implied by documentary precision and permanent records.

This affords the potential for swift and simple resolution of disputes. It also allows the participants to take advantage of many of the little features of face-to-face communication that help it run smoothly. These may perhaps be no more than prosodic indications of status and role, but they intersect with rituals and practices on the site that have deep historical roots. Local, creative solutions to problems have always been a feature of construction, and have always depended on people's experience-based understandings of how to work with each other, how to elicit required details, how to promote collaborative focusing on a task. Even though technical design and manufacture has replaced the oral tradition of the master builder and craftsman, the fact remains that each newly developed system brought to a site has to be installed on the basis of hard-won practical knowledge, refined skills, and detailed discussion. From the point of view of the enthusiast for pristine technology and process, these aspects may constitute undesirable "dirt" in the system, but they cannot be abolished. Grease in a machine may appear extraneous and dirty, but its role is nonetheless central in keeping the mechanism working smoothly.

5 Formality and revelation

On the other hand, informal communication runs the risk of unresolved misunderstandings, fails to support retracing of the situation if some problem develops later, and does little to capture successful solutions for future application in similar situations. In a construction project, there is a main contractor, who has the task of coordinating all the other players — this is a difficult job in any circumstances, but it is only made more difficult by the other players communicating informally among themselves without keeping records, something the mobile phone seems to facilitate remarkably well. Overcoming these drawbacks is an objective legitimately pursued by those who introduce formal systems. There are in fact good reasons to frown on the use of mobile phones among construction workers. But what emerges here is clearly a tension between the longer-term needs of the activity overall and the immediate needs of those involved in carrying it out.

In principle, it looks as though we can help with this by creating a system in which everything is very clear and well-defined. We can develop an ontology that covers all

of the aspects that might need to be discussed, and make sure that all the terms it uses are well understood by all the participants. We can, if necessary, have a hierarchy of ontologies, so that things can be characterised at the appropriate level of detail. Then the use of this system can be incorporated into the processes that are defined for documentation and dispute resolution, etc.

In practice, this continues to fall foul of the problems surveyed in the last section. There is always the potential for people to have differing understandings of concepts included in the ontology, and so great is the diversity of people involved in construction that these differences are bound to emerge. The ontology will be used to define a general interpretation of a term, intended to cover all of its uses; but such generality is inevitably a "lowest common denominator" — that which is in some sense shared by the majority of the known or normal interpretations. We may want people to stick to this, but in practice they cannot, because their own context informs and enriches their natural interpretation of a term, and more importantly this is often a necessary aspect of employing the term effectively in relation to that context. The general interpretation simply lacks the degree of resolution needed to apply it to a specific situation.

One apparent route to a solution is that the ontology can be extended and complicated to an extreme degree, with hierarchical sub-ontologies for all imaginable special cases. Ultimately, this will fail, because it will be unwieldy and there will always arise special cases that have not been imagined. Another approach is recommended here. We can recognise that an ontology is useful as a set of guiding principles to how the domain is structured and where important issues are likely to emerge. We can keep the ontology at a relatively high level of abstraction, but recognise also that differences in interpretation will crop up. In fact, we should embrace these differences and celebrate them as indicators that conceptual clarification is required. Such clarification will proceed by discussion and negotiation, which will open up and relate differing perspectives on the concept. The role of the ontology, on this view, is therefore to identify key terms in the area of activity and to reveal differences of interpretation that arise in relation to these, rather than to pretend that there are no differences and force them underground where they are addressed only by the illicit and ambivalent practices that we have mentioned.

6 A related perspective

Work in cognitive science has shown that when people are working together on a communicative task, they tend to develop their own "conventions" about how to use language for that task. This happens very quickly, even in a simple experimental situation where people play a game that involves identifying positions in a small maze drawn on a grid [6]. It happens between pairs, but also spreads to a whole "virtual group" when the members work in successive pairs until each has worked with all the others. (A "virtual group" is defined purely by who has worked with whom, and the group members do not realise that they form a group.) The task is then performed very smoothly by pairs drawn from the group. However, if there is more than one such group they will evolve different conventions, and then if a pair is put together from two different groups the task becomes much more difficult for them. This is a quite robust phenomenon and has been found to occur also with

communication using drawings rather than language, where participants evolve and adopt simple but obscure symbols that are very difficult for others to understand [5].

Its relevance to the present discussion is the analogy with groups working together, say on a series of projects for a particular contractor. This sort of group will develop its own communicational styles and shortcuts. Moving from project to project, the group will interact with others, and in each case will be like the people drawn from different groups. Communication will be possible, of course, but it will be less smooth and more prone to error than when communicating within the group.

A key point in this analogy is that adopting the use of an ontology is unlikely to change things radically. It is probably true that adopting a standardised method of referring to locations in the maze would improve inter-group communication in the Garrod et al. maze task, but differences in the uses of this method would still arise and gradually accumulate. Similarly, in the graphical communication situation, standard symbols could be defined, but small differences would appear in the ways these would be drawn, and eventually quite different symbols might well emerge after all.

We could even, in this situation, try to characterise the differences between the groups' communication conventions by describing their divergence from the standardised method. So the standardised method in this situation has a value, but its value once again is to reveal the differences between the communicating groups, and to allow us to assess and take account of these.

7 A useful process

Key to the successful revelation and exploitation of these differences is the process of negotiation, which is a very useful process in a number of ways. Communication in construction contexts will often be concerned with the resolution of various kinds of problems, hence processes of problem solving are important. Negotiation is a valuable problem-solving tool.

We have noted that the standardised ontology is necessarily defined at a comparatively general conceptual level. Problems, however, typically arise with issues that are highly specific to some particular instance or exemplar of a general concept. To the extent that approved procedures and protocols are laid down at the general level, it's necessary to bring them to bear on the particular by bringing the latter "under" the generalisation. How one does this is in some sense a matter of perspective: the instance has to be seen as exemplifying the general concept, and there will quite likely be more than one possible way to do that. Here is one source of divergence between individual understandings of a description of the problem situation when general terms are used. A process of negotiation about how the problem is to be described will begin to expose this divergence.

This process might appear to be wasteful, in that it creates multiple expressions of what is supposed to be the same thing. Ambiguity will emerge, there will be unnecessary complexity. However, another way of looking at this is that it creates redundancy, the value of which, within communication, has been explored elsewhere [11]. As in certain kinds of computer systems, this can result in greater "fault-tolerance" in argumentation and a more robust solution in a problem situation. While

the process may be somewhat messy, there is a greater chance that an eventual tidying up will not have missed anything.

But also, in problem solving, there is often a premium on proliferating expressions or representations of the problem. This is obvious in design, for example. Sketches, models, discussions; all are employed as externalisations of thinking that very often give rise to new perspectives, further thinking, and further rounds of representation. This can be extremely fruitful. In collaborative problem solving, of course, these externalisations are critical to ensuring that the collaborators are aligned in their thinking and can maximise the extent to which they aid each other's work. Negotiation is a process that exactly fosters this kind of mutual expression of individual understandings of how the particular can be made sense of in general terms. It is therefore likely to have a strong facilitating effect on problem solving. In the present context, the value of this is to be contrasted with the effect of applying a standard solution and perhaps missing the subtleties of the particular case that may cause that solution to fail.

Again, to return to ontologies, we therefore want to exploit (or perhaps we should say subvert) them in the role of facilitating collaborative problem solving by using them to propose wholly negotiable terms in which to begin the characterisation of a problem situation. At present, this is not something that most developments involving ontologies do much to support.

8 Ontologies and Platonism in the construction industry

There seem to be various things that we might want to use ontologies to help with, e.g.: consistent specification of products; product data exchange; building performance modelling; assembly processes; communication … — These may not all have the same implications for design and use of ontologies. Current developments tend to focus very much on the first three or four items in this list. There is a strong relationship between ontologies and various efforts to standardise "product models" in the building context, such as the IFCs (Industry Foundation Classes) being developed by the International Alliance for Interoperability (IAI). Whereas data exchange standards for a long time focussed on the syntactic level of how information should be represented, the widespread use of XML now encourages standardisation efforts to shift to the semantic level of the things about which information should be represented. The original philosophical meaning of "ontology", as essentially a description of "what there is", is sometimes thus taken rather seriously, and the ambition may be to create a standard, exhaustive and correct listing of all relevant concepts in the construction domain. Where more limited, the restrictions on the ambition seem usually to arise in the extent of coverage of the domain attempted, rather than the nature, status or usage of the representation intended to be achieved.

There are many problems with this general idea, among them that change and innovation are stifled and that varying perspectives cannot be accommodated [10]. For all the reasons we have discussed, these features alone are fatal to any attempt to support communication. This might seem odd, in as much as any ontology ultimately arises from communication. The only access we have to the concepts in play in a domain is overt communication between the players. In the building domain, we study the documents, the drawings, the databases, the responses of experts when

questioned — all of these things are communicative artefacts that embody the conceptions we seek to formalise. So one might have thought that any ontology thus derived would surely be well suited for facilitating those same communicative processes. But the error here is an old one. Plato, no less, thought that things in themselves had ideal Forms, and that if we could only represent these Forms we could avoid all the "imperfection", dirt and mess associated with our lowly corporeal being and the inevitable inadequacy of the languages (and other communication systems) that we set up between us. Similarly, both philosophical and technological theorists have sought to abstract from the messiness of language to capture a shared, underlying set of ultimately correct concepts. However, one insight that Plato had, apparently lost on many contemporary ontologists, was that actually representing the Forms would for us always be impossible, since we cannot escape our corporeal being. So any system we set up to try to capture the ultimate nature of things will be at best some sort of rough approximation, subject not only to correction and revision, but also to challenge from alternative conceptualisations offering equally valid representations. This seems a pedestrian observation now, but still it is at odds with many of the objectives of standardisation work with ontologies. And, long after Plato, we have seen the emergence of views, such as those of Wittgenstein [13], implying that communicative practice itself is ultimately "what there is".

Rather than a Platonic vision of construction, then, we urge a view in which "dirt" is in the eye of the beholder (cf. [8]). Douglas [4] illustrates the problematic of dirt as "matter out of place"; if something appears as dirt it is as a result of one's perspective. From another perspective, the same thing might not be considered dirt. Plato thought that everything (on Earth) is dirt, but we allow that some things may be elevated, for certain purposes and in certain contexts, to the more sublime and abstract status of representations that can be treated at least as markers of current agreement to be given priority in discussion. We therefore advocate also a Rabelaisian vision of construction as a carnivalesque activity [8][9] that celebrates dirt, because it is only by contrast with what is otherwise considered dirty that anything emerges as clean, and because at least periodically activities should be promoted in which the clean and dirty are mixed to see whether a more useful perspective on the distinction between them can be found.

9 Dishing the dirt?

Following this line of thought, we would see as valuable a system that collects dirt, where it arises, and instead of disposing of it preserves it, so that it can be dished out in circumstances where it might be useful. If we can retrieve ourselves from metaphor, this amounts to saying that we would like to promote negotiation and discussion of a relatively informal kind, but ideally we will allow this to occur in some environment that facilitates capturing its important content. At some stage, the discussion material might be used to reconfigure the ontological concepts from which it initially derived; at the very least, it will allow some account to be taken of the differing understandings of those concepts that arose in some specific context.

This idea is perhaps not very different from the idea of capturing discussion that surrounds the collaborative development of a conceptual framework, which is something that happens all the time in design. The large body of existing work on capturing argumentation and "design rationale" is therefore highly relevant. Space

precludes a detailed summary of this work here. The classic work of Conklin and Begeman [3] on IBIS and gIBIS remains a good starting point; see also [1]. For present purposes, it suffices to emphasise that the point of such a mechanism would be to integrate with the ontology to provide a flexible system that tracks local convention and concept development.

The uses of this kind of material could be various. Sometimes, it would be of very temporary relevance. Like the sketch on the plasterboard wall, it might relate to a quite specific time and place, focusing and refining the ontology for a purpose that simply disappears after a short time and can be forgotten without loss. At other times, it might record a major dispute between, say, a steel erector and a cladding contractor, about the precise description of a framework component. In this kind of case, the outcome could be of lasting relevance for the project in question, and possibly many others. It might then indeed be fed into refinement and development of the ontology itself.

10 Ontology mapping

As noted above, ontologies cannot hope to be definitive of the ultimate reality of some domain. And, of course, in practice it very often is the case that several ontologies are developed by different groups or companies, intending to capture broadly the same conceptual field. This is certainly true in construction. In this situation, one is naturally faced with the problem of how these perhaps rather different ontologies relate. They should relate at some level, one supposes, since they are aimed at the same underlying subject matter.

Already, a number of formal approaches have been developed to addressing this problem, usually along the lines of defining a mapping relation between the ontologies. Systems such as Ontomorph [2] are emerging, which analyse the structure of ontologies to derive morphisms (e.g. homomorphisms) between them at various levels. These systems usually have relatively little to go on, beyond the bare graph-structure of the conceptual network in the ontologies. We do not here envisage the attempt to map an entire ontology onto another, but one might focus on a situation where a particular node is in question, e.g. one is trying to make sense of two intending collaborators who come together to work on a particular aspect of a building, bringing different ontologies with them. In a case like this, it is possible, at least, that the process could usefully be assisted by a record of how this particular node is discussed by the parties, and possibly of how it has been discussed in previous such cases. Whether, and if so how, it might be possible to automate any of this process, we do not here speculate about, but such a system might be valuable purely in support of the negotiation process.

11 Conclusion

We conclude by restating that the use of ontologies in construction should be conceived as the development not of a system that defines the domain in sufficient detail to obviate disagreement and confusion, but rather of a system that attempts to reveal, structure and capture, and thus help to resolve, the disagreement and confusion that is inevitable in such a complex situation. We must remain sensitive to the differing conceptions of different groups or communities of practice acting together on the building site. We should beware of seeking to exclude the “dirt” and

sheer messiness inherent in communication, because the pristine is commonly also the sterile (cf. [7]), and because the carnivalesque encounter with dirt is often the stimulus to reconsideration and renovation of tired structures and orientations.

This proposal is obviously not without its difficulties. Capturing rationale and negotiation is notoriously difficult in practice, introduces problematic overheads, and can itself become a focus for unwelcome sanitisation and standardisation. But nothing is gained without cost, and it can hardly be claimed that the straightforward and naïve application of standard ontologies is any less fraught. We hope at least to have provoked the idea that some alternative to that should be sought.

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15.4. CARNIVAL AND CONSTRUCTION: PRESENTED AT ECAADE 2006

This paper was not a collaboration, it was one of the first papers in which I draw together and articulate the main themes of creativity and information mediation using Carnival as a structure for this articulation.

Carnival and Construction: A scaffold for the inclusion of ICT in construction process

Abstract

In this paper we explore the process of construction, we consider the construction site as a mediated collaborative environment in which many specialist crafts and esoteric skills are present and negotiated. Concrete information when pass onto a construction site becomes part of a fluid morphing object, the validity and meaning of information can change—or be lost—depending on where and when it is. We look at current models of construction and actual construction process and we explore the notion of Carnival as a tool to reconcile the concrete and fluid aspects to communication dynamics of mediated group working in general and of construction site practice specifically.

1. Construction

Increasing construction process efficiency of is one of the main goals of much of the research surrounding construction. There are two main approaches; re-modelling the construction process (Kagioglou et al., 2001, Li et al., 2002) and the insertion of an ICT (Information Communication Technology) to improve the process (Kagioglou et al., 2000, Peansupap and Walker, 2005), the latter acknowledging the need for investigation into the actual point of work activity (PoWA) on construction sites as much of the current work is funded by—and often limited to the offices of—Construction Organisations.

A Creative Locus

As such the creative aspects of the construction site are often over shadowed by the procedural and litigious aspects which dominate within these organisations. For anyone who has ever been involved in arbitration, the ‘litigious’ reality of construction underlies many of the existing practices and processes in the design and construction environments, and necessarily must underlie much of the research. For a moment however lets set aside this litigiousness, and look upon a construction project not merely a place in which health and safety regulations must be obeyed and instructions must be carried out in a linear/modular fashion, but rather lets look upon it as a locus of creative action.

Mediated Environment

The construction site is a complex/hybrid mediated space which I have explored elsewhere (McMeel et al., 2005), it is an inter-mediate state and the inhabitants appropriate various hi/lo technological communication tools (sketches on walls, drawings, phone calls) in order that they all provide their specific contribution when and were necessary. The processes of communication within it are highly creative, complex and in many cases esoteric as a particular team of tradesmen might speak a particular vernacular—or even as is becoming more often the case a completely

different—language, all of which must be overcome to negotiate the making of a building. I would suggest that sanctioned/formal modes of communication in such an environment could not fully represent or convey such esoteric information.

Fragile Information

When these formal communicative systems do represent such information it is in danger of being mis-represented when they do not represent such information it becomes fragile and in danger of being lost. Within an environment such as the construction site, which is constantly in a fluid state, the perception and validity of specific information that is delivered in quantitative or schematic form from an office environment can accidentally be changed or be lost when it enters a construction site causing costly delays or confusion.

The relevance of a particular piece of information not only depends on who has it and where they have it but most importantly it can depend on when they have it. This information sketched on a plasterboard wall (fig 1) regarding the position of insulation and the air gap required is right beside the location where the detail is applicable and it is relevant to the location until all the insulation and plasterboard is erected, at which point it will become redundant and will be subsequently plastered over.

[FIGURE]

Figure 1. Construction detail sketch on plasterboard.

Carnival

Carnival is an event, which on the surface may not seem directly related to construction, however it too involves a complex negotiation of official and unofficial channels, it involves protocol and procedure, it is noisy and dirty but yet can involve incredible sophistication within its rituals, it also includes esoteric behaviors and modes of communication all of which are embraced within the participation. So there is—at the very least—an engagement within the event with the unofficial elements of the society rather than a rejection of them.

2. Current Models

The most widely accepted model of construction is the RIBA Plan of Work (Cox and Hamilton, 1995). On site activity features as only one of the twelve stage Plan. Eight of the previous stages being dedicated to design and planning. It has been suggested that this model is no longer representative of the process (Lawson, 2004) and several new process models have recently been put forth.

Constructions Next Top Model

Lawson (2004) has investigated holistically the design/construction process and having analysed the workings of the designer concluding a unified model is unlikely due to the individualistic and complex nature of the process. Construction only plays a small part in Lawsons analysis, Kagioglou (Kagioglou et al., 2001) looks more closely at the specifics of construction and maps a potential model from the manufacturing sector onto it. Later in 2000 (Kagioglou et al., 2000) he suggests a generic model for the construction process which sets out to reduce the changes which typically occur when a building eventually starts on site. Peansupap and

Walker (2005) opts not for models but for recommendations for implementing ICT and identified PoWA on construction sites as a key areas for investigation, but the scope of their research was limited to ICT implementation in construction organizations not specifically on construction sites.

What's in a model?

During pre-construction we expend vast amounts of time and energy to create and agree on accurate documentation for the purposes of construction. What we are in fact agreeing on is quantities, a cost and a series of schematic graphic representations of what each party will contribute. These graphic representation are inherently ambiguous, as such the 'virtual building', the notion of a completely unified virtual representation of a building before it is constructed is gathering momentum but is not without its problems (Plume and Mitchell, 2005). Such virtual models need to be incredibly accurate and robust, more robust in fact than designers typically used to constructing.

To ruthlessly plagiarise an analogy of construction perhaps rather than a 'model' (from the Latin meaning 'thing to be imitated'), we need a scaffold (from the Latin meaning 'prop' or 'support'), which would then enables the creation of that 'thing'.

ICT Interventions

Proprietary ICT's often struggle for acceptance on construction sites, the digital Hardhat was rather cumbersome and new devices required staff to be instructed in their usage (Peansupap and Walker, 2005). Where they are adopted it is predominately in the management or monitoring (COMIT, 2003) of a process rather than assisting that process. Never the less ICT's have infiltrated the construction site, while we developed proprietary applications the humble mobile phone swept in and proliferated. While phones are loaded with tools and toys, a survey conducted by the author indicated only very elementary usage of phone functionality (phone, text, alarm) yet they have made considerable impact, and are both adored and loathed on the construction site.

An analysis of phone usage was undertaken and is currently being tabulated to understand where this very affordable, robust and usable ICT is benefiting and being problematic in relation to PoWA on construction sites.

3. Construction and the Carnival

Like construction, Carnival was a complex, sometimes seemingly chaotic event, explored by Rabalais and Bakhtin (1984) it embraced participation of many forms and from many people including those that were ordinarily expelled beyond the bounding walls of the medieval city in which it was held. In these instances 'dirt' was kept proximate and allowed to return so it can be engaged with during Carnival, looking at key Carnival phenomenon we can relate them to the construction site and group working.

Dirt

It is suggested that proximity and engagement with the seemingly unwanted—the dirt—affords creativity, Hyde (1998) in Trickster makes this World warns of the

dangers of simply removing this ‘dirt’, suggesting that the process of purifying can result in sterility. Douglas (1978) however illustrates the problematic of dirt as “matter out of place”, if some ‘thing’ appears as dirt it is as a result of ones perspective. From another perspective, the same ‘thing’ might not be considered dirt. This challenges many systemic assumptions that dirt and rubbish are tangible things that can be placed in a distinct category and expunged. This perhaps allows us to reframe certain communicated information as this kind of dirt and reconsider our tendency to completely erase it.

Graffiti

Historically and contemporarily graffiti is a means of ‘unofficially’ marking or leaving a message, from the stonemason who marks each carved stone and the posting of messages on statues and deities during Carnival. More recently Banksy a contemporary graffiti artist highlights another aspect of graffiti, “Imagine a city where graffiti wasn’t illegal. A city that felt like a living breathing thing which belonged to everybody.” (from www.banksy.co.uk). The presence of graffiti shows life and occupation, it is considered a temporary phenomenon and as such feels current, immediate and alive. Subversive in nature it is also suggested here that it creates a feeling of ownership or community, not just by the individual creator but by all individuals who interact with or see it.

Graffiti has traditionally played an important role in construction and its rituals, from temporarily marking the ground as a means of laying out the geometry of the encampment or building, to the use of stonemasons’ marks. Graffiti also plays a role in contemporary communications. On the one hand contractual formalities (working documents, specifications, forms); the sanctioned communications on site, are virtually superceded as soon as they are released. On the other hand, messages scribbled on a wall (graffiti) are throwaway statements (dirt) or something else (paint colours, the location of a pipe or wire, an impromptu detail). What initially appears as graffiti becomes knowledge critical to the life of that area of the site. The graffiti—of momentary importance—will eventually become redundant and overwritten plastered or painted, and disappear.

Rumour

A message that passes through the crowd, it evolves and changes. We have seen rumour machines within the media facilitate an individual tarnish and end careers as effectively as they reveal political corruption. Leaving a residue of empowerment and faith in the cliché ‘one person can make a difference’. Rumour is a powerful phenomenon.

The unsanctioned channels of Internet and mobile ICT’s (PDA’s, mobile phones, texting, voice mail, camera-phones, video-messaging) seem to thrive on rumour, on construction sites they have subverted contractual communications which have yet to adapt to these new modes of communication and they undermine the traditional official modes which support legal and contractual processes which help to ensure the arrival at a satisfactory building.

Early response to the presence of these subversive mobile ICT’s by the custodians of construction site, the construction organisations is to limit and even ban them on construction sites. We conjecture that these communications promote creative

discourse through the rumorem (Latin), that is, the noise and clamor of the construction site that cannot be ignored.

Interlocution

Construction, a mediated space the goal of which is the collective production of a building. The theme of collective production has been explored by Attali (1985) in his analysis of the ‘game of catch’ in the painting ‘Carnivals Quarrel with Lent’. In the painting we see a group appropriate a water urn and re-invent its function within the game. The object has currency within the context of the game as it is tossed around and if returned to its previous state would also have value. However beside the players is a similar urn which has been dropped, once dropped and damaged it is no longer useful to the game or to its previous existence.

Within construction foremen are charged with this responsibility of moving objects and information around between the ‘players’ on the construction site. Pacheco was a site foreman who worked for architect and engineer Eladio Dieste. He was described as “a natural leader with an expansive personality, the ideal interlocutor between Dieste and the labour force” (Pedreschi, 2000). Dieste is often cited as a designer who engages in discussion and not just instruction.

During interview with site managers and construction organisation professional it was found that being able to redirect queries to the appropriate people was very valuable and mobile phones had facilitated this rather well. This type of information request only becomes problematic in an instance when like the urn it is ‘dropped’ and forgotten.

4. Conclusions

The drive for efficiency in construction seems to be looking towards an ever more concrete representation of a building and an assembly process akin to manufacturing. I would suggest that construction is a creative activity rather than a manufacturing process and have tried to explore it here as such. While construction models tend towards rigidity, we should perhaps consider creative activities that—like construction—have fluidity.

Currently the fluidity within construction seem to be in part enabled by mobile phones. In rigid construction models they are considered problematic (mainly by construction organisation directors), unlike formal methods of communication on construction sites there is little or no record of what is communicated through them (fig 2) and as such are problematic. Yet on the fluid construction site sub-contractors consider them very valuable when they require clarification or have to stop or change some aspect of their work package.

[FIGURE]

Figure 2. Critical information via TXT message.

Rather than a model that attempts to represent a form, perhaps the adoption of a metaphorical scaffold which does not dictate rigid form but instead supports it. Having accepted that there is considerable value in using mobile ICTs for point of work activities perhaps they need to be treated like the ‘dirt’ during Carnival. I suggest like Carnival the solution is not to expunge this ‘dirt’ or to integrate it into

the contractual or official channels where it would undoubtedly become sterile and loose its potency but to distance it and facilitate its periodic return.

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